THE

ELECTRICAL REVIEW.

VOL. XLI. DECEMBER 10, 1897. No. 1,046.

CONTENTS:

	PAGE
Incandescent Gas Burners	817
Electricity in Cotton Mills (*illustrated*)	819
Dresden Electric Tramway Companies	820
Rapid Tramway Building	820
Testing Storage Batteries (*illustrated*)	821
Three-phase Current Measurement (*illustrated*)	822
Reviews:—Manual of Electrical Undertakings, 1897	823
Calendar of the Glasgow and West of Scotland College, 1897—93	823
Telegraphic Signals and International Code Vocabularies	823
Journal of the Institution of Electrical Engineers, Nos. 129, 130, 131	823
A Systematic Treatise on Electrical Measurements	823
Some Tests on Incandescent Lamp Mantles (*illustrated*)	824
Correspondence:—Ozone Generators	826
Distribution of Electrical Energy	827
Re Shoreditch and its Dust Destructors	827
Submarine Telegraph Cables	827
Subterranean Rivers	827
The Engineers' Strike	827
Legal	828
Business Notices, &c.	831
Forthcoming Events	835
Notes	836
City Notes	840
Traffic Receipts	840
Share List of Electrical Companies	841
Lighthouses and Light-vessels (*concluded*)	842
Notes on Modern Practice in Electric Power Work and Recent Developments on the North-East Coast	845
A Novel Suggestion *re* Apprentices	847
Hertzian Telegraphy in France	847
New Patents and Abstracts of Published Specifications	848

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

PRICE 6/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1897.

PRICE 6/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGREKAY, LONDON." Code A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 4s.
BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.
CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.
READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d.
FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.
Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill E.C.

INCANDESCENT GAS BURNERS.

THE tests on incandescent gas mantles, which we publish on another page, are laden with interest, and ought to prove something in the nature of a revelation even to the Incandescent Gas Companies. Besides putting the whole matter in a definite and tangible form, they will be of considerable use in enabling electrical engineers to refute some of the extraordinary claims put forward on behalf of mantle burners. The most exacting could not quarrel with the methods employed by Mr. Medley in carrying out his prolonged tests; moreover, it must be remembered that the burners were tested under conditions most favourable to their well being. They were not exposed to sudden draughts, the testing room was thoroughly ventilated, and the greatest care was exercised that the mantles should not be subjected to shaking or other violent concussions. The able experimenter does not say whether or not he kept a bronchitis kettle going, but it is obvious that the mantles were treated with all the care that characterises the nursing of sick persons.

It is hardly necessary to point out how different are the conditions that surround a mantle in public life. The temper of the world has not materially improved since their introduction, and doors are still banged with vigour; our maid servants retain the virtues which have been extolled by generations of mistresses, and they still insist on leaving doors open and lighting the gas with a healthy pop. Notwithstanding, however, the assiduous cultivation and the delicacy of treatment that Mr. Medley bestowed upon his collection of mantles, the features that mark their performance in everyday life are completely reproduced in his experiments. There is the unexampled brilliancy of early youth, but the decrepitude of age creeps on at an alarming pace, and after a life of 100 hours the candle-power falls away in a most remarkable manner, and by the time the burners have existed 500 hours, they may be yielding but 50 or 60 per cent. of their initial lighting power. It is common knowledge that if incandescent burners do withstand the incidental shocks of existence, the lighting power rapidly diminishes; but it was not generally suspected that the decay was so rapid as Mr. Medley's experiments suggest. The very nature of a burner pre-disposes it to dissolution, and it is only a matter of time to bring complete disintegration.

There has never been a lack of enthusiasm among the advocates of incandescent gas lighting, and we are willing to concede that where the use of gas is a compulsory evil, incandescent burners are a mitigatory agent. But enthusiasm is often times responsible for recklessness, and hence some unreasonable statements of Mr. de Fonblanque, the secretary of the Incandescent (Welsbach) Gas Light Company. One always approaches the assertions made in a newspaper interview with some misgivings, but the *Sunday Times*, which has recently collated Mr. Fonblanque's opinions on the relative cost of using incandescent gas burners and electrical lamps, is so reputable a journal, that we do not hesitate to

accept the statements as correctly reproduced. In the light of the tests which we publish on Mr. de Fonblanque's burners, the assertions are edifying. One is as follows: "In the lighting of a Swansea church there were 74 burners, and the cost of the gas consumed was 9d. per hour, and the lights gave 8,000 candle-power in the aggregate. To obtain the same candle-power by electricity would, according to an estimate submitted to the churchwardens, have cost 6s. per hour."

If no greater distribution of light were wanted than that produced by the 74 burners, we maintain that it could be done at a cost of 8s. 6d. per hour even at 6d. per unit. It is a common practice in many towns to charge places of worship as low as 3d. and 4d. per unit, and thus it would not be difficult to bring Mr. Fonblanque's figure down to 1s. 9d. or 2s. per hour for electric lighting. It is hardly necessary to-day to urge that in many places of worship it would be cheaper to use electricity even at 6s. per hour than to use gas at 9d. per hour; moreover, it must not be forgotten that the lighting hours in a church are less than 100 per annum.

There are many more exaggerations which Mr. Fonblanque perpetrates that are too palpable to need refutation, but we should have thought that even he would not have had the hardihood to say that "an incandescent electric lamp lasts only 200 to 300 hours, so seven or eight renewals per lamp per annum would be required to keep up a light of 16 candle-power, *i.e.*, 26 or 30 renewals per lamp per annum to keep up a light of 60 candle-power, as compared with two Welsbach mantles." In other words, we are asked to believe that two Welsbach mantles will give 60 C.P. each for 1,500 hours; the best answer to this is the result of Mr. Medley's tests.

Wireless Telegraphy.

THERE are two errors in connection with wireless telegraphy that are being constantly repeated, viz., that Marconi has done nothing new, and that the British Post Office neglected the work of Dr. Oliver Lodge and took up that of Marconi. When such a statement is reiterated by so eminent an authority as Prof. Silvanus Thompson, one feels constrained to enter some protest. At a lecture on "Signalling without Wires," recently delivered at the London Institution, Prof. Thompson, after very properly extolling the magnificent work of Hertz and Lodge, asked what had Marconi done? Nothing new! But surely before Marconi came to this country there had been no serious attempts at signalling over considerable distances. We presume if either Dr. Lodge, or even Mr. Tesla, had thought they were so near such striking results, they would have been unceasing in their efforts to carry the experiments a little further than they did. Moreover, we feel sure that if Dr. Lodge had brought something definite before the British Postal authorities they would have taken up his discovery as readily as they did Marconi's. At the same time, whatever may be the commercial future of systems of signalling across space, its development may be said to be due to the minds of many.

Winning Nickel by Electrolysis.

NICKEL, standing metallurgically between iron and copper, can be won by methods analogous with those proper to both the latter metals. Thus sulphide ores may be run to a mat, and oxide ores directly reduced to crude metal. A similar relation is evident in the behaviour of metal when treated by the wet methods of extraction, which resemble those for copper. Although this process will not serve for the direct precipitation of metal, its similarity to iron prevents such easy reduction. Since electrolysis has been brought to bear upon the winning of copper, and with so great a measure of success, attention has naturally been turned to the production of nickel by the same or allied processes, but hitherto many difficulties have been encountered. However, the advocates of electrolysis are so steady in their determination to overcome these difficulties and make electrolytic processes commercially possible, that already the production of nickel in this way can almost be considered as a recognised process of manufacture. Foremost amongst those who have engaged their attention upon the production of nickel by electrolytic methods is F. Foerster, whose papers in the *Zeitschrift fur Elektrochemie* have probably been read by many of our readers. In a recent issue of the *Zeitschrift*, *vide* No. 4, pages 160 to 165, Foerster describes experiments made with carbon as anodes, but it seems that he did not obtain very successful results, for the carbon employed very quickly became soft and broke down in the hot nickel chloride solution. It is possible, however, that better grades of carbon might yield more satisfactory results, especially if lead peroxide be used as the anode, and the solution worked with be a sulphate. Most of Foerster's recent work, however, has been carried out with soluble nickel anodes. This is, of course, the method used in the electro-plating of nickel, but hitherto only thin coatings of the metal have been obtained, the metal soon becoming scaly and parting from the electrode. This is a difficulty which everyone is familiar with who has ever done any electroplating with nickel, but Foerster states that it can easily be overcome by keeping the temperature of the electrolyte at anything over 50 and up to 90° C., in which range he has succeeded in forming tough deposits of the metal both from solutions of the sulphate or the chloride. On the whole, Foerster prefers the solution of the sulphate, and he works with a concentration equivalent to 145 grammes of commercial nickel sulphate per litre at temperatures between 50 and 90°, and with current densities varying from 0·50 to 2·5 amperes per square dcm. A higher current density yields a lighter and smoother metal. With the same current and more concentrated solutions of nickel sulphate (equal to 100 grms. of nickel per litre) the metal was deposited in a dull rough state. It seems that with an increased concentration a denser current is required, for, from the solution last referred to, the metal was obtained at the cathode in a bright silvery-white condition, using a current of between 2 and 2·5 amperes per square dcm. The cause of the irregularities and roughness noticeable in the deposit is due to the formation of bubbles of hydrogen at the cathode, which tears up the surface. In a large scale experiment, 0·50 kg. of nickel was deposited upon a cathode of 2 square dcm. superficial area. The solution used contained 100 grms. of nickel per litre; the current density employed was 1·5—2·0 amperes; the temperature was maintained at 60° C.; and the E.M.F. required, with the electrodes at a distance of 4 cm., was between 1·0 and 1·3 volts. The nickel obtained was exceedingly tough, and the author concludes that, using hot solution, the electrolytic deposition of nickel upon any scale of operations is possible. The composition of the deposited nickel is effected by any iron and cobalt which the crude metal may have contained, and the separation of these three metals is not possible by alterations of the E.M.F. and current density, unless the nickel solution be treated with tartaric acid and an excess of sodium hydrate. Working with a solution of nickel chloride, it was found that the difficulty of producing a firm tough deposit from the cold solution was not eliminated when the solution was heated, for under these latter conditions basic chloride makes its appearance at the cathode. However, Foerster did succeed in preventing the currents of this impurity, by adding to every 100 cc. of electrolyte 0·25 grm. of hydrochloric acid. Under these conditions, very satisfactory deposits of nickel were obtained from solutions containing 5 to 12 grms. of metal per 100 cc. at temperatures ranging from 50 to 90° C., and by means of currents ranging in density from 0·70 to 3 amperes per square dcm. The greater the current density and the degree of concentration of the electrolyte, the tougher and the lighter in colour was the deposit. In his paper Foerster describes the character of some of the alloys of nickel and iron obtained in attempts to deposit nickel electrolytically from solutions containing much iron. Other experiments are also described, and on the whole this last paper of Foerster's may be regarded as a useful contribution to our knowledge of the subject.

ELECTRICITY IN COTTON MILLS.*

By W. B. SMITH WHALEY, Columbia, S.C.

Electricity as a means of transmitting power has been considerably dealt with in several very able papers before this society; and it is not my purpose to take up valuable time in covering again ground which has been only too well and ably investigated, desiring to give only the results of my experience with electricity as a means of transmitting power in a cotton mill. Its many useful dispositions have been described fully, but in every case we lack direct comparison from actual practice which would picture it to us in its true commercial light. It is the purpose of this paper to attempt to describe from the actual operation of two plants working under as nearly identical conditions as two manufacturing institutions can—the one operated by rope transmission with heavy head shafts, sheaves, &c., and the other by means of motors distributed throughout the building. In one the actual operation of the steam engine is considered; in the other the current is supplied to the motors from the secondary switchboard or receiving station.

Many have considered electric transmission in the light of a source of power, and we often hear comparisons on it with regard to power costs, which are very misleading. Some have been imprudent enough to assert its economy for power purposes in connection with uneconomical water-power plants, as the means of making such developments commercially available; and several large plants for cotton mills have been developed on this line with such blindness as to their true commercial value from an economical standpoint, that room is left for well-founded scepticism of their true value when compared with the many other more economical installations which might have been effected. Electricity's true position, for power purposes, is that of a transmitter; and whatever the source of power, the point to be considered is its efficiency in connection with that source for transmitting purposes. Having settled that, our investigation then leads to its comparison with other well-known methods of transmission.

For the purposes of this paper, we will take up the investigation, by tabulated data, from the actual every-day operation of the plants. The period during which the conditions as regards the working load were approximately the same was between April 1st and June 25th, 1897, and we shall designate the two plants as No. 1 and No. 2. No. 1 is a steam driven mill, having a steam plant geared up with ropes, heavy head gearing, and large tapering shafts, as such plants are usually geared up in the best practice of to-day. The steam engine is an 800 horse-power Corliss cross compound, built in 1895, with cylinders 20 and 40 by 60 inches stroke, and a rope wheel 24 feet pitch diameter, grooved for 26 1¾-inch ropes, weighing 35 tons. This engine is being operated at an exceptionally low cost per horse-power for steam. There was in the mill during the period for which comparison of power is made 11,776 spindles and 720 looms; all the spindles and preparatory machinery were run full, but the looms did not average more than 682 per day. No. 2 is an electric-driven mill which rents its current from a central station and distributes it through a continuous-reading wattmeter to four 150-horse-power inverted motors bolted to the ceiling in convenient locations for economical distribution of the power, and belted to the shafting. The mill has been in operation since January 1st, 1897. This mill had in operation during the period named above on an average 12,448 spindles, with preparatory machinery, and an average of 356 looms out of 500 in the mill. The weight of the shafting in the steam mill is approximately 136,000 lbs., and in the electric mill 122,000 lbs.

* Paper presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers.

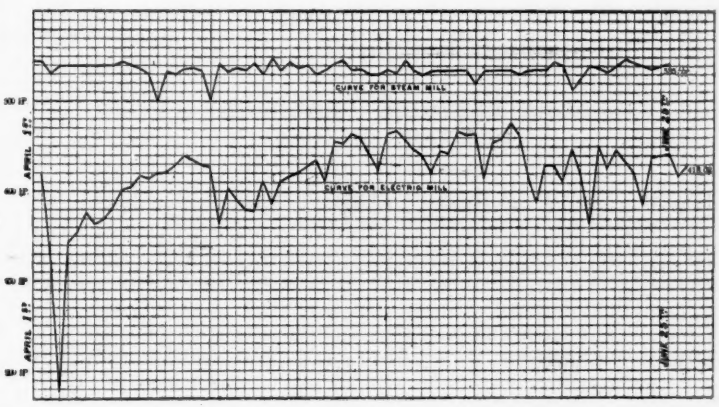
Power in Each Mill.

From the diagram showing the power curves in the two mills during the period alluded to, we find that the average in the steam mill is 535·71 horse-power for all purposes (this mill is only partly filled with machinery and is using not quite two-thirds of its full power). From indicator cards taken, we find that the power required to drive the shafting and belting on loose pulleys only is 228 horse-power; for the 720 looms and shafting, only 349 horse-power; and for the whole mill, 595 horse-power. Deducting the friction horse-power from the power required to drive the looms and shafting, and dividing this result by the number of looms, we obtain the power required to drive one loom, which is 0·168 horse-power.

Deducting the power required to drive the looms and shafting from the total power gives us 246 horse-power, which is the power required to drive the spindle and preparatory machinery. This amount divided into the number of spindles gives us 60 spindles per horse-power, including the necessary preparatory machinery for this number of spindles.

At the time the data given above were obtained, there were in operation in the mill 14,848 spindles, with the necessary preparatory machinery, and 720 looms.

In the electric mill, owing to the lack of suitable instruments for testing the separate motors, we were unable to find the amount of power expended in friction, and consequently, having only the average power consumed, we can compare the mills by using the data obtained from the steam mill to bring the electric mill to the same basis. From the power chart we observe that on an average 418·2 horse-power per day were used in the electric-driven mill during the period above alluded to, namely, from April 1st to June 25th. During that period there were in operation on an average 12,448 spindles per diem and 357 looms, as against the steam mill operating 11,776 spindles and 682 looms.



From the data obtained from the steam driven mill, we have the following distribution of power during the test—for the steam driven mill,

Total power.	Looms and shafting.	Friction.	H.P. speeds.	Looms.
535	340	226	196	114

and for the electric-driven mill,

Total power.	Looms and shafting.	Friction.	H.P. speeds.	Looms.
418	206	149	208	60

Hence the difference between 226 horse-power and 149 horse-power, which is 77 horse-power, must be credited to the electric mill in its present condition.

The following points from the foregoing can be stated as existing under the present conditions: the steam mill is operating under a disadvantage of an underloaded engine; the electric mill is operating under the disadvantage of driving more shafting per motor than it will when the full complement of machinery is installed.

The steam mill requires more supplies in the shape of oil, sizing for ropes, and other necessary incidentals due to the method of transmitting the power. The electric mill has

cost nothing for its motors in six months of operation, not even the necessity of putting oil in the bearings, which was simply renewed once in that time as a precaution. The convenience of operating any section of the mill *ad libitum*, without reference to the other sections, is an advantage which is felt in dollars and cents in plants using electric transmission.

The question which arises as to whether a generator directly connected to an economical type of engine to produce the power would consume the difference in the frictional horse-power, is one which can only be answered from data from institutions having such plants. It is the author's opinion that this difference of power would not be exceeded, and he hopes subsequently to give more specific data from further experiment from the actual operation of these two plants under better conditions, viz., when both mills are completely filled with machinery and motors and engine run at their full load; also in obtaining the efficiency of direct connected engines and generators.

It must be borne in mind that, unlike a machine shop and other manufacturing establishments, where a large amount of shafting is required to cover the ground and where intermittent power is used, a cotton mill drives in useful effect 95 per cent. of its shafting, and uses actually in continuous operation almost the maximum power at all times.

In presenting this paper the author hopes that it will awaken enough interest in others to induce them to collect and present to the society useful data which they may have relative to this very important subject.

DRESDEN ELECTRIC TRAMWAY COMPANIES.

Dresden, with a population of 354,285 inhabitants, has two competing companies operating electric traction, viz.: The Dresden Tramway Company, and the German Tramway Company; both doing a brisk business, continue to extend their lines.

The yearly statistics of these companies show a steady increase in the number of passengers, and a decrease in the percentage of accidents. The following tables only refer to the length, system, wagon-kiloms, daily runs, watt-hours, passengers, and accidents of the Dresden Tramway Company, which embraces the three systems of traction: overhead wire, accumulators, and underground conduit:—

Section of lines.	Length of lines in metres, and system of traction.	Average number of wagon-kiloms per month during 1897.	Average number of daily runs.	Current absorbed per wagon-kilom.
	Metres.			Watt-hours.
Blasewitz—Reichenbach Str.	5,900 overhead wire 1,945 accumulators.	125,000 by motor wagons 85,000 by tenders	900	560
Altmarkt—Striesen.	2,980 overhead wire 470 underground.	56,000 by motor wagons.	500	450
Alaunplatz—Georgplatz	3,420 overhead wire.	46,000 by motor wagons.	435	430
Georgplatz—Strehlen.	3,870 overhead wire.	55,000 by motor wagons.	466	420
Blasewitz—Laubegast.	3,860 overhead wire.	27,000 by motor wagons.	248	440

Month. 1897.	Number of wagon-kiloms.	Number of passengers.	Total number of accidents.	Number of accidents per 100,000 wagon-kiloms.
April	263,637	1,240,561	5	1·89
May	295,421	1,350,465	5	1·69
June	289,461	1,383,716	6	2·07
	848,569	3,974,742	16	1·88

County-Councillor, Mr. Ploetner, referring to the decrease of accidents on the lines of the two Dresden electric traction companies, pointed out with satisfaction, that the total number of accidents belonging to both companies during the first three months of the year amounted to 54, whereas during April, May and June they were reduced to 30; or, in other words, there was one accident to each 247,150 passenger during the first quarter, and one to each 305,570 passenger during the second quarter of this year; or one accident to each 54,558 wagon-kiloms.

About every 200 yards there is a "Hattestelle," a place for a short halt, to let passengers out and in, being marked by a visual board fastened to a pillar. People, however, insist upon jumping in and out of the cars when they are running, and this bad habit caused exactly one-third of all the accidents. In five cases of accidents nobody was hurt, nor was there any damage to rolling stock, and in nine cases material damage only took place. In two cases only was the fault attributed to the driver, whereas, during the first quarter, 17 such cases took place. A similar progress is observed on the part of all other street vehicles, the conductors of which caused 25 out of the 54 accidents during the first, and only five out of the 30 accidents during the second quarter of this year.

Only 22 persons, including two children, were hurt in the 30 accidents of the April-May-June quarter, and out of these, 20 caused their injuries by their own fault. Only five persons were seriously damaged.

These data prove that the servants of the electric traction companies, as well as the public, become more and more accustomed to the conditions of this means of conveyance, and that a further reduction of accidents can safely be anticipated.

R. v. F-T.

RAPID TRAMWAY BUILDING.

It has often been said that in this country one may safely count on taking three years at least from first starting an electric tramway project until the time when cars begin to run. First of all a whole year goes in arranging matters with existing interests — tramway company and local authority. Then another 12 months must be allowed for Parliamentary procedure, with as much again for actually building and equipping the lines.

The same rate of progress (*progress*, mark you) seems to prevail whether the track to be converted or built has a length of two miles or 20, and therefore it requires in many cases an average of at least one year per mile of line to carry out the work completely. As a rule, the contractor does most in the least time, and, though 12 months have been allowed in our imaginary case, he very often takes perhaps only half this. A mile a week of new and converted track is by no means an out-of-the-way figure for actual construction work, and we have seen it done.

It is with the local authority, the board of directors, or the State department, that so much time is wasted—literally wasted, and the hopes of a somewhat more rapid procedure under the Light Railways Act, ought not to be crushed by too much red tape opposition, as recent decisions would, we fear, indicate.

In the United States things are done a little less leisurely: and while English promoters have to plod along for 20 months to get powers and permission to equip two miles of track, they skip the question of rights or privileges in the States, and actually build the line in as many hours. "In medio tutissimi ibimus." We don't want either extreme if it can be helped.

Some time ago we chronicled a piece of very rapid construction work in the States, where rivalry between railroad and tramway companies led to the latter building a short length of line in something like 12 hours; and just now the American electrical papers find space for an account (evidently not considered, however, as being particularly remarkable) of a similar achievement—a length of about 2½ miles of new track being built, equipped, and operated within 24 hours.

As in the last case, preparations had to be made in secret, so that the rival company (running a tramway in this instance) should not interfere; and also the work was

arranged to start at midnight on Saturday, since the "injunction" factory of the State legal machinery does not apparently run on Sundays, and therefore no valid opposition could be raised until the Monday.

The arrangements—as may be supposed—quite resemble those which we consider appropriate to real warfare, the gathering together of a large body of men at a distance, the bringing them in a special train with all the necessary tools and horses, the lighting arrangements for the entire stretch of line, the hauling and distributing of material, inclusive of 250 tons of rails, besides sleepers and trolley wire poles, not to speak of providing shelter and food for the men—all must be good practice for the contractors if they should ever be called upon for military service: and our own new electrical engineer volunteer corps couldn't do a better service to London, or indulge in better evolutions than set to work some Sunday in a similar fashion, and violently equip one of our Metropolitan tramways. Indeed, we shall not be surprised if the L.C.C. were to take the hint and engage the services of these valiant gentlemen, for its new project of a tramway along the Embankment. What is Parliament or law and order compared with the L.C.C.?

To return, however, to the feat accomplished by the American contractors, it is of interest to note that in ten hours the track throughout its length on the macadam highway had been graded, and a large part of the rails laid and bonded. The poles and brackets for overhead construction were also erected, and the work of stringing trolley wire begun. During the afternoon of Sunday, the weather got as bad as it could, but the work went on rapidly. A special feeder about 2,000 feet long was erected to connect the line with a private electric lighting plant in the neighbourhood, specially re-arranged for the purpose of supplying current to the line, and at last, about 11 p.m. on Sunday night, a trolley car, brought up in great secrecy, was started on the line, travelling easily over the entire length, and thus in some way not understanded of us "preserving or maintaining the franchise"—we should say "creating" it. To judge from the illustrations given in our American exchanges, the line was not of the "jerry" order, but seems at least to be a good average, according to American ideas, and by no means inferior to the type of light railway which we hope to see in this country for agricultural service. We say this with the more confidence from knowing that the contractors were Messrs. J. G. White & Co., who carried out the Niagara-Buffalo transmission line work.

TESTING STORAGE BATTERIES.

By RANKIN KENNEDY.

The discussion on Mr. Epstein's paper, and especially the remarks of Prof. Ayrton, brings out some results of tests which, to say the least, are somewhat peculiar.

There is a great amount of confusion among statements of results of tests, and it is almost impossible to get at results which can be relied upon. This does not arise from errors in measurements, nor, as a rule, from errors in calculations, but from a wrong interpretation of the figures obtained. In few reports do we find the most important statements as to the size of cell tested; this is overlooked in most cases. For instance, the E.P.S. 15-ampere cell weighs 153 lbs. per kilowatt-hour, the 38-ampere cell 113, and their 83-ampere cell 107 lbs. per kilowatt-hour; and smaller cells than 15 amperes keep running up in weight at an increasing rate. Now, the 15-ampere cell is quite as good in every way as the 83; the only difference is that one has five plates, the other 23. Yet if a report was made of a test on these two cells, without calculating upon the difference in size, the small cell would be condemned as weighing 30 per cent. per kilowatt-hour more than the large one.

Now, if we take a list of batteries and begin with the smallest, we can make a curve showing kilowatt-hours, rate of discharge and weight (see figure).

With a curve like this worked out for a line of cells, it is possible to compare cells when they are of large or small sizes.

Thus a small cell may be submitted for tests and turns out 190 lbs. per kilowatt-hour at a discharge of, say, 2 amperes; simply compared with the 121 lbs. given by the 30-ampere E.P.S. cell the test would quite unfairly condemn the cell. To make a fair or an approximately fair comparison, a curve showing the fall in weight as the cell is enlarged must be made; the cell can then be marked off on the curve and its true value nearly estimated.

The weight curves of all cells are nearly alike. Beginning with 2 or 3 amperes it rapidly falls at first, then more slowly until at about 100 amperes it becomes a straight line.

E.P.S. Weights per Kilowatt-Hour.

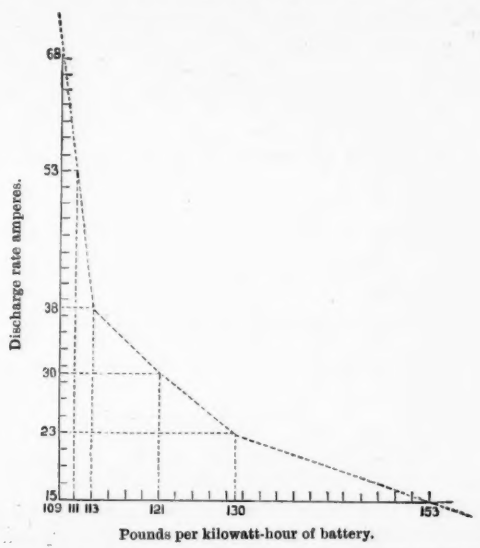
Amperes.	Weight. Lbs. Per kw. hours.	Difference in amperes.	Difference in weight. Lbs. kw. h.
15	153	8	23
23	130	7	9
30	121	8	8
38	113	15	2
53	111	15	2
68	109	15	2
83	107		

At the small discharges we get a difference of 23 lbs. for an increase of 8 amperes; at the large outputs we get a difference of 2 lbs. with an increase of 15 amperes; these results are very interesting, and go a long way to explain the conflicting accounts given of battery tests.

From the foregoing table and curve it will be seen that the E.P.S. cell when it reaches a size for 53 amperes begins to drop in weight at a constant rate, namely, 2 lbs. for 15 amperes increase.

Unfortunately, all makers do not give the same full and complete details as the E.P.S. Company do, hence comparative curves cannot be shown, but wherever such particulars are to be had it is worth while making out a table.

It is possible by making a test on large cells, carefully prepared for a test, by selecting a specially thin box, making



Curve Showing Fall in Weight per Kw. Hour in Storage Battery as its Ampere Rate of Discharge Increases.

the plates fill it so that there is not a drop of superfluous liquid, and then by taking discharges with intervals of rest, to obtain marvellous results which are never again obtained in practice, even with the same size of cell. On the other hand, it is possible by taking a small cell and by running it off at one discharge, and then publishing the result, without drawing attention to the size of the cell, a result may be got which looks very poor indeed, while if it were intelligently considered and compared on the curve, would really be better than the wonderful results from the big cells.

Cells to be tested and compared with other cells must be taken of similar discharge rates, or they must be reduced to similar discharge rates by multiplying or dividing by the constants found in a curve such as I have indicated, or a rule must

be made that all tests should be made on batteries of a fixed rate of discharge, say, 50 amperes; without observing these rules reports on battery tests are absolutely worthless, and yet in the discussion on Mr. Epstein's paper, although some speakers referred to the peculiarities in reports of battery tests, only one speaker referred to this very point, which is of the utmost importance.

Testing experts must agree upon some rules for tests, otherwise their reports which should be taken as the very embodiment of truth will not be accepted as of any value.

THREE-PHASE CURRENT MEASUREMENT.

By LAWFORD H. FRY.

The following method, which is in use in the electrical laboratory of the Hanover Polytechnikum, for the measurement of power transmitted by a three-phase current is very simple, and has the advantage of being very economical in the number of instruments required, and in the time needed for a measurement. The switchboard shown in fig. 3 enables the whole determination to be made by means of one wattmeter. Only two readings are necessary, their sum giving us the power being transmitted.

The method is applicable to both the closed, or triangle system of connections, and the open, or star system; being

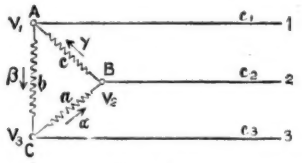


Fig. 1.

dependent on the fact that at any moment the sum of the E.M.Fs. and the sum of the currents are zero.

Take the case of the triangle system of connections. Consider the system at any one instant. In fig. 1 let B C, C A, and A B, represent the coils of the dynamo. Let the absolute potentials of the points, A, B and C, be V_1, V_2 and V_3. Let the E.M.Fs. in the coils be α, β, and γ, respectively.

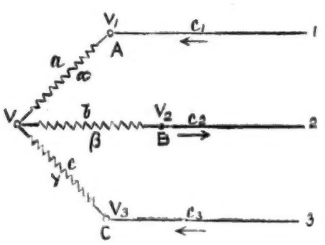


Fig. 2.

Represent the currents in the coils at this instant by a, b and c. Let the currents in the external wires be c_1, c_2 and c_3, and the potential differences between the wires be p_{23}, p_{31} and p_{12}. Now, if W be the energy put forth by the dynamo, this will be the sum of the energies in the coils, *i.e.*,

$$W = a\alpha + b\beta + c\gamma,$$

but
$$\alpha = V_2 - V_3$$
$$\beta = V_3 - V_1$$
$$\gamma = V_1 - V_2$$

$$\therefore \alpha + \beta + \gamma = 0$$
$$\therefore \alpha = -(\beta + \gamma)$$
$$\therefore W = -(\beta + \gamma)a + \beta b + \gamma c$$
$$= \beta(b - a) + \gamma(c - a).$$

But the algebraic sum of the currents flowing through any point must, according to Kirchhoff's law, be zero.

Hence for the point, C,

$$b - a = c_3,$$

and for the point, B,

$$c - a = c_2.$$

Again, β is obviously the potential difference between the wires 1 and 3, *i.e.*, $\beta = p_{13}$.

Similarly $\gamma = p_{12}$

Thus we have $W = p_{13}c_3 + p_{12}c_2$.

We shall obtain the same result for the open or star system of connections. Let fig. 2 represent this system. With the same notation, as in fig. 1, we have as before

$$W = a\alpha + b\beta + c\gamma$$

but in the present case Kirchhoff's law gives $a + b + c = 0$ for the point V.

$$\therefore a = -(b + c)$$
$$\therefore W = -(b + c)\alpha + b\beta + c\gamma$$
$$= b(\beta - \alpha) + c(\gamma - \alpha).$$

Now, the potential difference between the wires 1 and 2 is $\beta - \alpha$, and that between the wires 1 and 3 is $\gamma - \alpha$, *i.e.*,

$$\beta - \alpha = p_{12} \text{ and } \gamma - \alpha = p_{13}.$$

And obviously $b = c_2$, and $c = c_3$.

Consequently $W = p_{12} \cdot c_2 + p_{13} \cdot c_3$.

We have to measure the two products. The switchboard, of which fig. 3 is a diagram, enables these two measurements to be made with one wattmeter, with a very small expenditure of time. The board bears three switches, I., II. and III. in the figure, and two selectors, P and C, the one for the potential, the other for the current measurements. The connections on the board are all permanent, and are arranged as shown in fig. 3. The wires for the main current are indicated by full lines, and those for the potential measurements by dotted lines. In the Hanover switchboard the

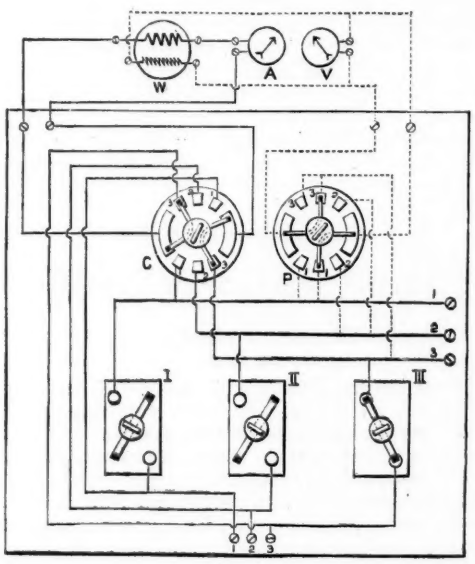


Fig. 3.

measuring instruments are not permanently attached, but binding screws are placed ready for the wires for the instruments, as indicated in the figure. The Hanover switchboard is quite plainly made, and is fastened to the wall near to the three-phase dynamo.

To make a measurement the board is inserted in the circuits by means of the six binding screws for this purpose, which are shown in the figure at the bottom and right hand side.

The three at the bottom are for the wires from the generator, and the three at the right hand side are for the wires leading to the consumer of power. The measuring instruments have now to be connected up. This is done as shown in the diagram, the potential coil of the wattmeter, and the voltmeter being connected to the two binding screws at the left of the top of the figure, and the current coil, and

the ammeter to the screws at the left of the top. The method after which the connections on the board is arranged is so simple as to be at once apparent on an examination of the figure.

To insert the potential coil and voltmeter between two wires of the system, we simply turn the potential selector, P, till it assumes the sort of position shown in the figure, with its arms on the contacts connected with the two wires with which we are concerned. The contacts being numbered to correspond with the wires to which they are connected, this will be simplicity itself. The introduction of the current coil and ammeter into a circuit is but little more complicated. The current selector, C, must be turned till the arms come onto the contacts, which bear the number of the circuit into which the instruments are to be inserted. Then the switch corresponding to this circuit must be opened, otherwise the ammeter would be short-circuited, and the other two switches must be closed.

Now to make an energy measurement according to the scheme of the formulæ obtained above. Set the potential selector, P, with the arms on the contacts 1 and 2, and the current selector with its arms on the contacts numbered 3. Then the wattmeter reading gives the product $p_{12} \times c_3$. Then set the selectors so that the wattmeter reading gives the product $p_{13} \times c_3$.

The sum of these two products will be the number of watts of energy being put forth by the dynamo, at the same time the volt and ammeters give the potential and current at which this power is being transmitted. If many measurements are being made it will be useful to note that the wire, which occurs in both potential measurements is the wire in which we do not measure the current. Thus, if the potential differences measured are p_{12}, and p_{13}, the currents will be c_2, and c_3; the current c_1, not being measured, for the wire 1 occurs in both potential measurements. We may also note that the products must be so composed that the number of the wire carrying the current factor occurs in the designation of the potential factor, thus, $c_2 \times p_{12}$ and $c_3 \times p_{13}$.

REVIEWS.

Manual of Electrical Undertakings, 1897. Emile Garcke. London: P. S. King & Son.

Considering the state of the electrical industry at the present moment, it hardly seems credible that the total nominal capital of the various classes of electrical companies registered since 1856 stands at the colossal figure of £178,000,000. Financial operations on a large scale commenced very early in the history of electrical work, and so far back as 1858 the registered capital of companies formed in that year alone amounted to over £5,000,000. The development of submarine telegraphy, which for nearly 20 years was the only application of electricity that monopolised the attention of scientific and financial men, called for large capital outlay, and considering the scale on which telegraph operations were carried on, it is not surprising to find that down to the year 1871 the registered capital of telegraph companies stood at over £41,000,000. Taking as our guide an admirable table which forms part of the preface of Mr. Garcke's manual, it is interesting to note from year to year the rise of the various branches of the electrical industry. The telegraphic business seems to have advanced at a steady rate of progression, and has been rarely marked with the financial eruptions that have marked the development of telephonic and electric lighting undertakings. In the rise of electric lighting, the one year that stands out prominently from all others is the year 1882, when the capital of companies formed to carry out electric lighting was nearly £13,000,000. The total registered capital of companies formed during that famous year was £23,000,000, and of this only £300,000 was to be applied to telegraphic purpose. Mark, however, how the retrograde movement followed this year of inflation; in 1883 the total nominal capital was £5,821,500, but in the following year it had fallen to £1,679,500.

Electric lighting enterprise became at this period completely discredited, and the low water mark was reached in 1885, when the total registered capital to be devoted to electric lighting purposes stood at £58,000. To indulge too much in retrospection might interfere with our review of Mr. Garcke's manual, which has now reached the second year of its publication. We declared, on an examination of the first year's manual, that it was a book that electrical men in all branches would find extremely useful, and now that a more complete classification of electrical undertakings is given, the utility of the work is greatly enhanced. The historical summary which formed so interesting a feature of the first book has now disappeared, presumably to make room for more utilitarian matter. The addition of maps of many electricity supply areas increases the value of the information given on electric lighting matters. With the author's facilities for obtaining information on traction matters, it was to be expected that the traction section would be very complete; it is nevertheless surprising to find electric tramways requiring so many pages of closely printed type. The size of the manual impresses one with the fact that the electrical industry, with all its various branches, must now take high rank among the commercial developments of the century.

Calendar of the Glasgow and West of Scotland College, 1897-98.

We see from this Calendar that the number of students who attended the evening classes in 1896-97 amounted to the large total of 4,135, of which 126 were "electrical engineers, opticians, and philosophical instrument makers." A number of the students appear to have obtained important appointments after leaving the college.

Telegraphic Signals and International Code Vocabularies. By James Nicolson. Glasgow: W. Asher, 80, Gordon Street.

The writer of this book is superintendent of the Compania Telegrafica del Rio de la Plata Buenos Aires, and the object of the work is to describe an improved "Combined Consonovowel Code and Signalling System," which consists of various selections of vowels and consonants arranged alternately, corresponding to telegraphic signals of alternate classified motions. The book is one which deserves careful study, as the argument that the suggested code will save about 33 per cent. in the number of letters required in a code word seems justified.

Journal of the Institution of Electrical Engineers. Nos. 129, 130, 131. London: E. & F. N. Spon, 125, Strand.

The following are the chief contents of these numbers:—129, "Some Recent Developments in Electric Traction Appliances," by A. K. Baylor; "The Generation of Electrical Energy for Tramways," by J. S. Raworth; 128, "On Some Repairs to the South American Company's Cable off Cape Verde in 1893 and 1895," by H. Benest; 130, "Disturbance of Submarine Cable Working by Electric Tramways," by A. P. Trotter; "Dynamos," by W. M. Mordey.

A Systematic Treatise on Electrical Measurements. By Herschel C. Parker, Ph.B. New York: Spon and Chamberlain. London: E. & F. N. Spon, 125, Strand.

The matter of which this book consists, originally appeared as a series of articles in an American monthly periodical. Mr. Parker, the author, is tutor in physics at the Columbia University. The work has been written in a very systematic manner, and although, avowedly, a compilation from standard works on the subject, has a considerable amount of new material. No attempt is made to explain the derivation of formulæ, but simply their practical application is given. The brief manner of dealing with some of the subjects may be instanced by the statement, "In making careful tests of long cables, a rather complicated set of observations is required, and a report based upon these is made." A rather large portion of the book is devoted to various forms of Wheatstone bridges. In a chapter on "Calibration of Bridge Wires," the "calibration of a rheostat" is dealt with, a concluding remark being, "Since this is a deflection method, thermal and inductive effects should be carefully corrected for," but how these careful corrections

are to be made, there is not the slightest attempt to indicate. A chapter dealing with (amongst other things) the determination of the ohm, endeavours to explain the matter in about a page, with the result that the reader is likely to be as well informed on the subject after reading the explanation as he was before.

On page 82, in speaking of the Thomson quadrant electrometer, it is stated that the E.M.Fs. are proportional to 2 $\sqrt{\text{deflections}}$;" what the constant "2" has to do with proportionality we fail to see.

As an introductory work, the compilation may be recommended.

Applied Mechanics. By John Perry, F.R.S. London: Cassell & Co., Limited.

Very great credit is due to Prof. Perry for the persistent manner in which he has fought against the cramped style of teaching in vogue to within the last quarter century. Doubtless he has been, as he says, met with some ridicule, but that is not a very terrible thing to face, even if backed by an army of learned professors of the old school. Prof. Perry states that what he has done is to carry out Sir Robert Ball's idea of quantitative mechanical work, using a distinct piece of apparatus for each fresh kind of experiment. A student measures things for himself, illustrates mechanical principles, finds the limits to which the notions of the books as to friction and properties of materials are correct, learns the use of squared paper and the accuracy of graphical methods of calculation, and, above all, really learns to think for himself. The vital necessity of putting theory into practice by experimental verification of every kind is strongly insisted upon, by which—and this is a very important point habitually neglected—a valuable knowledge of the errors we are likely to make in graphical calculation is obtained. We have more than once expressed admiration of the delightfully colloquial style in which Prof. Perry writes, and this style is prominent in "Applied Mechanics," and is, we are sure, a material help to students.

To go through Prof. Perry's work in detail is hardly necessary, it is enough to say that it cannot be too strongly recommended.

SOME TESTS ON INCANDESCENT GAS MANTLES.

By E. A. MEDLEY.

The growth in the use of the "Incandescent" system of gas lighting during the last few years has made the necessity for an inquiry into the efficiency of this method of obtaining light a matter of considerable importance, both to the general public, and also to the electrical profession; for the rapid strides made by this new illuminant render it a possible serious competitor with the electric light.

In 1893, while I was one of Prof. Ayrton's students at the City and Guilds of London Central Technical College, I made some life tests on the Incandescent Gas Light Company's burners, and during the last six months I have had the opportunity, in Berlin, of adding to these results tests on some of the several makes of "mantles" which can be bought in this country and in Germany.

The tests made in 1893 are now chiefly interesting as showing what improvement, if any, has been made in the mantles since that date, and it is not therefore necessary to go into them in detail. They consisted of life tests on one of the old A form of Welsbach burner, in which the mantle was supported by a side wire, and on a group of five C burners, in which the mantle is supported by a central rod, in the way which will be familiar to everyone.

The standard of light employed was a 2 candle-power Methven screen burner, used with pentaned gas, and the light from the incandescent gas burners was compared with this by means of a Lummer-Brodhun photometer. The rate of consumption of gas was measured by a Sugg's experimental gas meter.

The lamps were carefully protected from draughts, shaking, or accidental damage of any kind. They were burnt continuously day and night, and in order to imitate practical conditions, they were turned out and re-lit four times in every 24 hours.

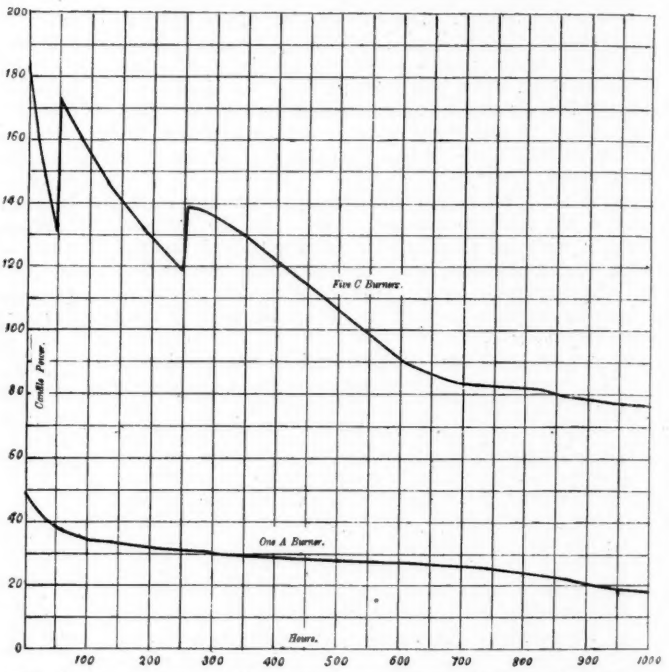


Fig. 1.—Tests Made in 1893 on the Incandescent Gas Light Company's Burners.

In the case of the A burner the measurements were made at a consumption of 3 cubic feet of gas per hour; in the case of the group of five C burners at a pressure of 1 inch of water, which gave a consumption of 17·2 cubic feet of gas per hour, or an average of 3·44 cubic feet per hour per lamp.

Mica chimneys were used with the C burners, but the diminution of light produced by these has been allowed for in the curves and figures, as in all the subsequent tests glass chimneys were employed. The light absorbed by these mica chimneys, as compared with glass ones, was 9·4 per cent.

The curves in fig. 1 show the results of these early tests.

It will be seen that the light from the A burner, starting at 49 candles, fell off rapidly, until at the end of 100 hours it was only 34 candles, thus showing a fall of 30·6 per cent. From 100 hours onward, although the rate of decrease was not quite so rapid, it still continued, until at the end of 500 hours the candle-power was 28 only. Therefore, in the first 500 hours, the light fell off by 42·9 per cent. At the end of 1,000 hours the light had further fallen to 18 candles, which represented only 32·8 per cent. of the initial value.

From 1,000 to 1,450 hours (this is not shown in the curve), at which point the test was stopped, the light remained constant at 18 candles.

From the curves for the five C burners (fig. 1), it will first be noticed that at two points, viz, at 50 and at 250 hours, the light emitted suddenly increased, the increases in each case being followed by a regular decrease.

There were no obvious reasons for these increases, the gas consumption of the burners had not altered, and no apparent change had taken place in the condition or position of the mantles.

In this connection it may be noted that, although in the many hundreds of measurements I have made on mantles, I have never again noticed changes so large as these, yet

it is certainly a fact, which must be familiar to all users of the incandescent gas lamps, that the light does vary from time to time to a quite appreciable extent, and without any apparent reason.

To turn to the figures. The light from the five burners fell in the first 500 hours from 187, or 37·4 candles per lamp, to 117, or 23·4 candles per lamp; that is, the light diminished by 37·4 per cent.

At the end of 1,000 hours the light had further fallen to

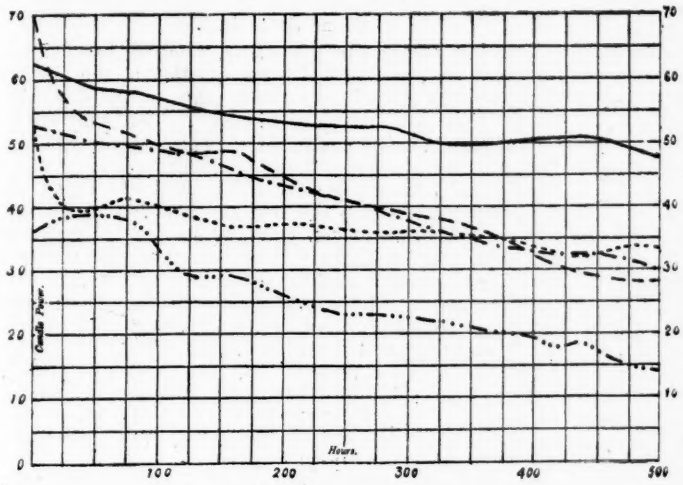
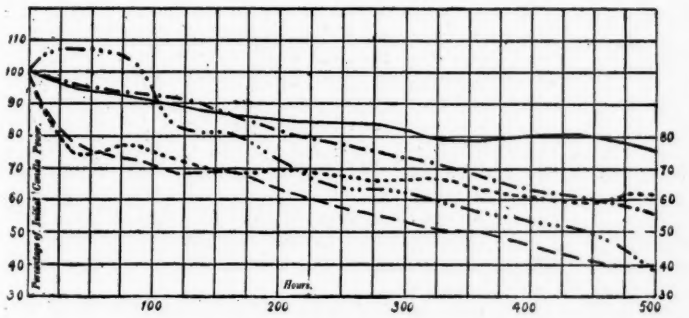


Fig. 2.—Candle-Power and Hours.

77, or 15·4 candles per lamp, giving a total percentage fall of 54·5 per cent.

It will be noticed that even when new these mantles gave a light of only 37·4 candles each, compared with the 49 candles of the older A mantle. I could only account for this at the time of making the tests by supposing that the set of mantles was rather below the average, unless, of course, the A mantle and one or two C mantles on which I made single tests, were above the average.



• • — • • Sunlight Co. — • — Incandescent Gas Light Co.
— — — — Deutsche Gasglühlicht Aktiengesellschaft ——— Stabil.
• • • • Neue Gasglühlicht Aktiengesellschaft.

Fig. 3.—Percentage of Initial Candle-Power.

We can now turn to the results of the tests made this year on the latest types of mantles.

Specimens were tested from the following makes:—

English—The Sunlight Company; The Incandescent Gas Light Company.

German—Die Deutsche Gasglühlicht Aktiengesellschaft; Die Neue Gasglühlicht Aktiengesellschaft; The Stabil Mantles.

The standard of light used was the Heffner amyl-acetate lamp, but in the figures and curves the candle-power is given in terms of the English candle, which I have taken as being 10 per cent. higher than the Heffner unit.

As before, the photometer employed was a Lummer-Brodhun.

The consumption of gas was measured with one of Elster's experimental gas meters.

A portion of the testing room was curtained off for the photometer bench, and the greatest care was taken that both this curtained off portion and the rest of the room were thoroughly ventilated. This is a point of considerable importance, for the light from the mantles is immediately effected if there is not an ample supply of fresh air.

Each lamp was brought in turn to the photometer bench and separately measured. The horizontal candle-power in three directions was measured by turning the lamp round through three successive angles of 120°, and the mean of these three readings was taken as the candle-power of the lamp at the time of measuring. Each lamp was measured, as a rule, once in every 24 hours of burning.

The rate of consumption of gas for every test was 115 litres (4·07 cubic feet) per hour.

Great care was taken that the mantles should receive no damage from shaking, or from sudden lighting of the burners; and, indeed, in these respects they may be said to have received exceptional treatment, as the care which I exercised would certainly not always be extended to them in actual practice.

The curves in fig. 2 show, up to 500 hours, the mean of the results obtained for each make of mantle.

The curves in fig. 3 show the same results, but the candle-power is given as a percentage of the candle-power of the mantles when first lit.

Looking first at the English makes.

The Sunlight Company's mantles, of which I tried several, were so very much below the light-giving power of the other makes that I made life tests on two only. The first started at 45 candles, and fell in 250 hours to 20·7 candles, and I did not test it further. The second mantle started at 27 candles, *rose* during the first 80 hours to 36·9 candles, and then fell steadily, until at the end of 500 hours it was giving a light of 13·6 candles only.

These mantles give a light of a pleasant reddish colour.

Of the English Welsbach mantles made by the Incandescent Gas Light Company I made life tests on two, and they gave very similar results. The first started at 54·6 candles, and fell in 500 hours to 32·4; the second started at 51·4, and fell in the same time to 27·9.

These mantles were made a good deal too large for their burners, with the result that of the first two I put on the burners, one shrank up all out of shape, and the other did not incandesce properly all over. The two on which I made the life tests were rather more satisfactory.

Turning to the German mantles. The Welsbach mantles made by the Deutsche Gasglühlicht Aktiengesellschaft, since they are made from the same fluid, should, presumably, have given similar results to the English Welsbach mantles; and, as a matter of fact, as can be seen from the curves on fig. 2, after the first 100 hours there was little to choose between the two makes. The German mantles, however, gave a good deal more light when quite new. This was probably due to the fact that they were very well made and fitted their burners perfectly.

Altogether three of these mantles were tested. One started at 78·3 candles and fell in 500 hours to 23·4 candles. Another started at 68·4, and fell to 26·1 candles in 500 hours. The third gave, when new, 64·2 candles, fell in 500 hours to 35·4 candles, and 140 hours later it had further fallen to 30 candles.

The results from the Neue Gasglühlicht mantles it is not necessary to consider in detail, as they are inferior to the

Welsbach makes. Three specimens were tested; one for 640 hours, in which time it fell from 54·9 to 26·3 candles. The other two were not as good as this, and were tested for shorter times.

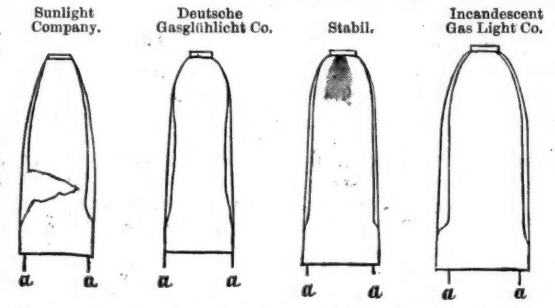
We now come to the Stabil mantles, which, as can be seen from the curves in figs. 2 and 3, were far superior to any of the other makes I tried. Of these, three mantles also were tested. When new, they gave 64·8, 60·3 and 62·7 candles respectively, while after 500 hours burning they were still giving 52·2, 43·9 and 45 candles. This last mantle I continued to test until it had been burning for 850 hours, after which time it was giving 32·6 candles.

The following table compiled from the average curves in figs. 2 and 3, gives briefly the main features of the results of the tests.

Make of mantle.	Candle-powers.			Percentage fall in	
	New.	100 hours.	500 hours.	100 hours.	500 hours.
Sunlight Company ...	36	33·4	14	7	61·2
Incandescent Gas Light Company	52·9	49	29·7	7	43·8
Deutsche Gasglühlicht Aktiengesellschaft ...	70·3	49·7	28·2	29	59·9
Neue Gasglühlicht Aktiengesellschaft ...	53·5	40·3	33·3	25	37·7
Stabil	62·6	57·1	47·5	9	24·1

The effects of use on the appearance of the mantles, the way in which they shrink and often wear into holes, must be so familiar to everyone, that it is hardly necessary to go into them. The sketches in fig. 4, showing these effects on some of the mantles tested, may, however, be of interest.

The blackening which sometimes appears on a mantle after it has been in use for some 400 or 500 hours is rather curious. At first I thought it might be due to the burner



The outer lines show the outline when new, the inner lines after the test. *a*, *a*, shows the size of burner.

Fig. 4.—Appearance of Mantles before and after Testing.

being dirty, or not burning properly; but removing the blackened mantle to another burner, which showed no tendency to blacken a newer mantle, neither get rid of nor arrested the growth of this deposit.

The general results of these tests are made sufficiently clear by the figures in the table given above. The mantles give a wonderfully good light when new, but the extreme rapidity with which the light falls off, and the consequent shortness of their efficient life, even when treated with every consideration due to their somewhat delicate constitutions, makes them far from an ideal illuminant. And, with the possible exception of the Stabil mantles, a great deal of improvement is necessary before, for domestic lighting at any rate, they can be considered even satisfactory.

In considering the prospects of incandescent gas lighting, it must be borne in mind that as soon as the master-patent for the Welsbach mantle expires, that is in about two years from this date, this country will be flooded with mantles "made in Germany" and elsewhere, just as it is now flooded with foreign electric incandescent lamps. This process has for some time, notwithstanding patents, been in progress in Germany, and it is now possible to buy a different make of mantle in almost every street in Berlin.

And, although one reads in the advertisements of the English companies a good deal about "worthless" imitations, it is certain that some of the imitations in Germany, as witness the Stabil, are as good as, or better than, the original.

The prices of the mantles are also bound to go down. I, myself, have bought mantles in Berlin for less than 4½d. each, a price which certainly cannot leave a very large margin for profits on sensational capital.

CORRESPONDENCE.

Ozone Generators.

I am just writing a book on ozone, which will be published early next year, and in which the question of the electric effluvia, and of the influence of the shape of the electrodes will be fully dealt with and discussed. This is my excuse for not having, before now, upset the heretical theory of Mr. Beanes on the merits of the flat plates and the demerits of the points. I do not see the object of the paragraph on ozone generators which appeared on page 783 in the last number of the Electrical Review, but the extraordinary and unjustifiable statements it contains, compel me to refute them, because they are neither scientific nor correct.

There are several kinds of commercial ozonisers: some consist of concentric tubes (Siemens), others of flat plates Du Moncel (1855), Beanes (1865), Ladd (1866), or of glass tubes containing a metallic rod, Schneller-Wysse (1890), Fabrig (1890); flat plates have again been patented: Otto, Yarnold, and others (1895-1896). Dielectric plates have been discarded altogether by Schneller, Van der Sleen, Tindal, Meister (1893, 1894, 1895).

My electrodes consist of point-bearing grids, facing point-bearing grids or flat plates.

A large surface can be obtained without necessarily using flat plates.

Mr. Beanes has perhaps introduced the flat plate ozonisers in this country, but Du Moncel was the first to use them. For a long time I believed that Mr. Beanes was the first inventor of the ozoniser with flat electrodes, but I have since ascertained that the production of ozone by the electric current, between two flat metallic plates, separated by a dielectric, was already known, and had been described in several publications 10 years before Mr. Beanes had his condenser constructed. I may add that in 1865 Jean made some interesting experiments with an ozoniser consisting of flat electrodes. I can, if desired, quote the extracts from *Les Comptes Rendus, de l'Academie des Sciences l'Institut, La Lumière Electrique*, &c., to substantiate these facts.

Everybody has been at liberty for the last 40 years to produce ozone by means of flat electrodes, the use of which is public property. Flat plates may *offer a large "area,"* but what is to be gained if on this large surface much less ozone is produced than on the point-bearing electrodes?

It is not correct to say that *experience has shown that points should be avoided;* but repeated experiments which I have had made have satisfied me that ozonisers working under the same conditions of size, circulation of air, voltage, amperage, and the determination of ozone taking place by the same analytical method have constantly shown that point-bearing electrodes give at least 20 per cent. more ozone than flat electrodes.

I am quite prepared to prove this in the presence of witnesses, and at the same time it will show that the writer of the paragraph is not well qualified to treat this subject of electrostatic ozone.

I reply, point by point, and joking apart, to the eccentric criticism of the point-bearing electrodes: *For the successful production of ozone*, electrodes *must* not *be as highly charged with electricity as possible.*

There are no *sparks*, but only the glow of the silent discharge, produced with point-bearing electrodes.

Capacity for the production of ozone *has nothing to do with point-bearing electrodes*, and the yield of ozone cannot *be diminished when the electrodes are not highly charged.*

Every one knows that the air must be filtered, and it is all nonsense to say that small solid particles will *become* (*sic.*) *deposited on the electrodes and that sparking may ensue.*

What shall I say about, *There is doubt that nitrous vapours* (*!*) *will be found as the result of sparking.* Sparks, indeed! Can the supercilious critic of the points tell us

where they are? Sparks! My eminent and learned critic has mistaken the silent discharge for sparks? He ought to know that by the inductive action of the charged metallic surfaces (separated by glass and a stratum of air), the intervening air becomes charged with electricity oppositely upon the two sides, and a discharge takes place through the air, not in the form of sparks, but diffusely producing a glow of purplish light, visible only in the dark.

It would be tiresome and tedious to have to refute such stuff as the remainder of the long paragraph I allude to; is it possible that it is an electrician who wrote it? Ozone is like poesy: many people talk about it, very few understand it, and that is why ozone is the most fertile and suggestive subject for people who talk at random.

Last month there was an American doctor in London who was offering in the City and the West End an apparatus for producing thousands of cubic feet of ozonised air at a nominal price. Unfortunately for him, he called one day on a manufacturer who happened to know something about the subject, and who allowed him to spin his yarn of wonders worked by ozonised air. Suddenly he asked him, What is the quantity of ozone contained in your ozonised air? The doctor was taken aback by this question, but he soon recovered, and with *aplomb* replied that ozonised air means air which has absorbed the quantity of ozone required to sweeten foul casks, oxidise oils, &c., and, he added with a smile, you can judge of the proportion of ozone by its smell. Then, replied the manufacturer, it is something like whiskey in water. Exactly, said the doctor. Well, in such a case, the strength of your grog depends on the quantity of whiskey you put in water, and the efficiency of your ozonised air depends on the quantity of ozone it contains. Can you tell me how many cubic feet of ozone there are in your 1,000 or 10,000 cubic feet of air? The strong and acrid smell of ozonised air is not an indication that it contains a large proportion of ozone.

To return to our subject, I positively deny the superiority of the flat over the point-bearing electrodes in the formation of ozone. How is it that, up to the present, none of the partisans of the flat plates have stated what is their yield of ozone per horse-power or per kilowatt? My best reply to the criticisms of point-bearing electrodes is that they can give more than 100 grammes of ozone per horse-power-hour.

The proof of ozonising is in the ozone making.

Emile Andreoli.

[It was not an electrician who wrote the note, but Mr. Andreoli can surely see that it was based on Beanes's paper, and does not represent any ideas but his.—Eds. Elec. Rev.]

Distribution of Electrical Energy.

I have read Mr. Boot's letter to you on this subject, and if that letter contains the best defence for alternating current systems, they are even worse than I suspected.

I am quite familiar with the fact that they are reducing the number of transformers to a minimum, and have no doubt before long they will be reduced to the vanishing point.

I think it will suffice to leave the rest of that letter to the judgment of those interested.

Rankin Kennedy.

Re Shoreditch and its Dust Destructor.

It is never very wise to acknowledge an anonymous correspondent; men who are ashamed of their names, are invariably ashamed of their opinions.

If your correspondents, who doubt the accuracy of my statements, are *bona fide* enquirers after the truth, I shall be very pleased to receive their names, addresses, and credentials, and will make an appointment to show them over these works, and answer any questions, in reason, they may choose to ask.

We have nothing here that we wish kept secret, nor anything we are ashamed of; further than this I cannot say, except that it is not my intention to be drawn into a newspaper controversy.

H. E. Kershaw.

[Mr. Kershaw takes no account of our own queries, which cannot be considered anonymous in the same sense as remarks that appear in our "Correspondence" columns.—Eds. Elec. Rev.]

Submarine Telegraph Cables.

In the interesting article by Mr. Charles Bright on the "Construction, Laying and Repairing of Submarine Telegraphs" in your issue of November 12th, Messrs. Siemens Brothers are credited with having in the recent Amazon River cable (1896), "made what was a new departure as regards submarine telegraphy. The core of the shore end type, instead of being brass taped, was covered by a lead tubing, thus rendering it absolutely teredo-tight as well as air-tight."

Mr. Bright is probably unaware that the India-rubber core of the shore end portions of the Cienfuegos-Batabano cable, laid by own company in January, 1895, for the Cuba Submarine Telegraph Company, was protected by a covering of lead tubing.

We may mention that the shore ends of the Manzanillo-Santiago cable, which we have recently manufactured for the above company, and which left the Thames in the ss. *Grandholm* last week, were similarly protected.

J. F. W. Hooper
(*Hooper's Telegraph and India-rubber Works, Ltd.*)

Subterranean Rivers.

With reference to a leaderette on the subject of "Subterranean Rivers," published in the Review of December 3rd, and in which you are so good as to mention the paper on "Some Repairs to the South American Company's Cable off Cape Verde in 1893 and 1895," read by me before the Institution of Electrical Engineers during last session, I would remark that my own observations led me to believe in a submarine river outlet near to Cape Verde having been the cause of rupture to the cable on both the occasions cited. Several telegraph men during the discussion on the paper at the next meeting, in relating their own experiences of cable repairs on other Continental slopes, strongly supported this belief, their evidence going a great way to prove my theory a correct one.

Pages 23 to 29 of the printed excerpt from Journal *Proceedings*, Institution Electrical Engineers, Part 128, Vol. 26, contain the observations and remarks in question, and charts 1 and 2 in the appendix show (1) the direction of a probable channel way, or submarine ditch, from the coast in the vicinity of the lagoons mentioned on page 24, through the positions of the first and second breaks, and (2) the contours from 1,500 fathoms depth in to the 100-fathom line, which shows how all these curve in towards the gully, which is also mentioned on page 24.

As the wording of your article would convey the impression that I was simply stating the belief, and referring to the theory of others, I beg the favour of space for this letter.

H. Benest.

December 7th, 1897.

THE ENGINEERS' STRIKE.

As we had begun to fear last week, the Conference has so far come to an untimely end. It has been adjourned, because on the side of the men there seemed to be no power to decide matters, and the men as a body are to be appealed to, and their votes cannot be in before the 13th inst. The doings of the Masters' Federation are described by one London daily as ruthless tactics. This is all very well, but unfortunately they are the outcome of the equally ruthless tactics of the A.S.E., which for years has been smiting employers hip and thigh, one by one, and goaded them into federation. When a man borrows your best umbrella and uses it until he can look up through many holes of his own making, he is apt to look on that umbrella as his own, and feels hurt should you again bring it more within the sphere of your own influence. So for years the Trades Unions have been usurping the functions of the employers, and have done so for so long a time, that now the employers are trying to get back their own again, they are savagely attacked. When the *Engineer* stated some weeks ago that the Federation were fighting Mr. Barnes, not Unionism, it spoke very correctly. The employers' proposals at the Conference are all to the effect of freedom in their dealings, but the great stumbling block is the question of a minimum wage. There can be very little doubt that the minimum wage idea has been largely instrumental in keeping down the wages of the better men. A very large number of men have no ambition to earn good wages. They have no families, or have very little heed of them. They work two days and play two days, and no employer cares to keep them long. Such men have no ambitions, and when at work they only grasp the hammer midshaft, as the old saying goes. They are worth

half or two-thirds the wages of better men, and would be better off if compelled to work every day for as much as they now manage to earn in half a week. At the same time, the really good man would be better off, and would be better men if they could earn more money, and it is unjust to pay them less than they are worth in order that loafers should be paid too much. The Trade Unions are fighting for this minimum wage. If they win, one result will be that numbers of men grown old, and yet capable of a less than maximum output of good work, will be retired to the workhouse. An elderly man who could earn 30s., and live in comfort and self-respect, must be pauperised because a less able man must be paid 40s. Thousands of labourers, very often better educated than the more skilled tradesman, must remain labourers, because the A.S.E. insists they must be paid more than they are worth or not allowed to work at all. But why continue the argument? It is plain to anyone who will open his eyes to see, and the first three days of the Conference proved only too clearly that Mr. Barnes never meant to give up interference, nor does he intend to do so. He went back at once upon the arrangement which was come to and described it as provisional.

When the *Daily Chronicle* condemns the masters for refusing to arbitrate in this dispute, we confess that the next thing we expect from its genius is, that Lord Salisbury should consent to arbitrate as to the Isle of Wight. So the employers must arbitrate upon the question of their shop management, and must not even have the right to fix the speed of a lathe.

There is trouble over the minimum wage. The men hold that no man whom the employer thinks competent enough to employ shall be employed at a rate below a specified standard. Thus the unions throw upon the employers the onus of discharging men altogether from employment because they are not worth employing at the "standard" rate. In this way, of course, the union would be, in time, deleted of all members who did not come up to a given standard of efficiency. Not only does this strike at the old men, as pointed out by the employers, but it tends to greatly weaken Unionism. Now, especially with the superannuation fund gone, what are the old age prospects? Why, simply that the prospect of superannuation is thrown back beyond the age at which a man may be worth standard money. The hardship will tell chiefly upon older men who, on the shutting up of an old works, are unable to find fresh employment at full wages. They are not to be allowed to take less, so they are free—to starve. As piece-work is also *tapu* to trades unionists, such men may not even offer to work by the piece. We have known many men, apparently feeble and old, whose life would be a misery to them in idleness, and who, on their own special work could give many a younger man the go-bye for turnover. Is it not hard that such men, refused day work because old, should not be free to say: Give me piece-work to do, let me show what I can do. In respect of the 48 hours week, the employers distinctly refused to entertain the proposal, as they were convinced it was impossible in face of foreign competition. They further state that the difficulties have not been thoroughly considered by its advocates, notably in regard to double shifts without overtime. The employers also claim to have more exact knowledge of the truth as to foreign competition than the men or the general public can have. In this connection it seems to us that the boasted solidarity of labour throughout the world is an empty boast. Why if this solidarity exists do not the foreign brothers strike for shorter hours? Why continue 12-hour days and shed tears over the hardships of their brave British bull-dogs among workmen lashed by tyrant employers to nine hours servitude. No doubt it sounds well, but it won't wash. The foreign workman is the artful dodger among men, and shows his sympathy by a weekly driblet of cash about 1 per cent., or perhaps, but a tenth of 1 per cent., of the benefit in direct cash to his own pocket from the English strike. But who can blame him? It seems to us that if hours are to be reduced the A.S.E. would have done better to subscribe £20,000 a week—they could have raised it easily from their full membership at work—to bring German hours within, say, one of English. England might have begun to think of 8 hours then. In the meantime, orders are going fast out of the country—one for 58 locomotives has gone to America from a customer hitherto always sending to England. The *Daily News* cries out for concession in the matter of hours, and quotes several instances where 8 hours has succeeded, but evidently the writer to the *Daily News* has no exact knowledge of his subject. Apart from the driving which is practised in these works, there remains unanswered the question, Will the men do so much work in 8 hours when all shops are on the same hours, and the 8 hours' shops are no longer able to pick and choose specially able hands? The *Daily News* sneers at the employers when they protest that they would have to drive their men if on eight hours, and do not care to do so. Evidently the *Daily News* is again in ignorance. Everyone engaged in a workshop knows how unpleasant it is to be constantly driving men. We never met anyone who really did like it, and the worst drivers we have known generally preferred to delegate the duty to others. To the *Daily Telegraph* it appears as though the men's representatives came to conference without any clear ideas, that they have had to call a ballot of their members upon the question, whether the 48 hours be vital or otherwise, and concludes that the men's anxiety for conference was simply that it would be a means of easy let down. The *Daily Telegraph*, in fact, seems to be hopeful that the men will ballot for the resumption of work and waive the hours demand. As things now stand, it appears that everything remains where it did before the strike, and the men are to ballot for or against 48 hours after fighting 21 weeks to get them. Jules Verne described in one of his books how an American train, full of passengers, was rushed at high speed over a shaky bridge, which fell as the train safely got across upon *terra firma*, and how, when the feat had been accomplished, the leading spirit allowed a Frenchman to finish a suggestion. The Frenchman was going to suggest that the passengers should first walk safely over and the train should follow. So with the men's ballot. Had they been thoroughly canvassed before the fight and a full ballot insisted upon, and the fact put before them plainly with the prospects of the superannuation funds being wiped out, then possibly there would not have been a strike of 21 weeks, during which the wages lost must have mounted into millions. It is to be observed that the demand for 48 hours was made "having regard to the increasing efficiency of labour due to improved machinery and greater intensity." This claim might have been made with some reason if the American system of working had been allowed, but for years England has been deprived of the use of the improved machinery so far as its possible output is concerned, and as to labour being more efficient, it is common knowledge that it is not so, nor has there been that increase in intensity of application which is claimed. Work has become simply a byeword in many shops, and production much less than it was a few years ago, as the employers have shown in their instances of interference.

In the course of a very interesting lecture at Dundee, on Friday last, Mr. Arthur Diosy, the vice-chairman of the Council of the Japan Society, gave some very striking figures which bear upon the existing state of affairs in the engineering trade. At the present moment there is being made in the United Kingdom, machinery for Japan worth £1,000,000. Next year there would be three-fold this value to make, chiefly textile machinery. Britain has, in the past four years, built ships for the Imperial Japanese Navy to the extent of over 4½ million sterling, in addition to the large 6,000-ton steamers for the Japanese Steam Navigation Company. Two warships are now on the stocks for Japan, and are stopped building by the strike. Mr. Diosy said if he could place a guaranteed order before the Japanese Legation from a British firm, he could obtain a £4,000,000 order for ships. But he could not guarantee delivery, and already orders to the amount had gone to France, Germany and America, and he should like to see this fact written up in 7-feet letters in every workshop in Britain. Japan, in fact, was a great factor in the world now. We ought to cultivate the country for its trade, and when we have so few friends, we might respond to Japan's outstretched offers of friendship. Like ourselves an island, almost identical in population with ourselves, and a nation whose highway seems to be the ocean, Japan has a fair claim to the title of the Britain of the East. Her interests are ours, and it would be wisdom to keep in friendship with Japan. If the engineers' strike continues much longer the Japanese trade, like much other, runs a great risk of being lost, and there seems a very poor prospect of the termination of the strike. The only gleam of a prospect is shadowed forth in a speech of Mr. John Burns. Now, be it remembered, Mr. John Burns is he who encouraged the men on their ruinous path nearly half a year ago, with the promise that he would have it all over in a fortnight. Mr. Burns now sees two courses open: (1) To organise a national weekly fund of £15,000 by a convention of all the trades' unions; (2) To declare the strike at an end and get back to work as quickly as possible. He recognises the gravity of the situation of which he made such light when he set the ball moving, or helped to do so. The daily press reports are to the effect that the men will ballot for the continuance of the strike; if they do so we fear it will be because their leaders have again misled them. The aim of the employers is not, as stated, to smash the union or in any way to interfere with its legitimate functions. This is authoritatively stated on behalf of the employers, who say that they will continue to receive deputations from workmen, including union officials, that a refusal to fix a minimum wage is not an innovation, that in some districts there is at present no restriction of overtime, and that they are only anxious to remove the harassing conditions which have been imposed in some districts. On the hours and machinery question they maintain their attitude, and we must say we do not see any good can arise from re-opening any workshop unless full freedom in working machinery to its utmost be fully recognised. With the long hours and low wages of America and Germany, it is essential that England should, at least, not be hampered in the use of machinery. In America, indeed, we find wages nominally higher than in England, but the hours are so much longer, and the freedom of labour so much greater, that Americans can compete easily in many things on this side. If once the American system, so loudly called for by Mr. Burns, could be firmly planted in English shops, there would be very little need to fear either slack trade, foreign competition, or any fall in wages. The chief difficulty would be to find enough skilled men to do the work there would be to do.

LEGAL.

Howell v. Cymmer-Glyncorrwg Coal Company and Others.

At the Glamorgan Assizes, on the 2nd inst., Mr. Justice Grantham resumed the hearing of this case, a report of which appeared last week. In this case the plaintiff preferred allegations of fraud against the defendants in respect to an agreement to supply the Colliery Company with electric pumping plant, into which the plaintiff had been induced to enter in consequence of such misrepresentation and fraud. Plaintiff further claimed damages against the defendants Randall and Pritchard, and asked for an order setting a certain agreement aside. Mr. J. Eldon Bankes and Mr. S. T. Evans appeared for the plaintiff, and Mr. B. Francis Williams defended the Colliery Company and Mr. W. R. Randall; Mr. Abel Thomas, Q.C., M.P., Mr. Bailbache, appeared for Mr. R. K. Pritchard; while Mr. Arthur Lewis was entrusted with a watching brief on behalf of the Metropolitan Bank, who had advanced £3,000 to the defendant company on the security of the "B" debentures. Defendants denied the fraud and misapprehension, and made various allegations.

Mr. Williams, addressing the judge, submitted that there was no case to go to the jury, and if there had been any fraud it was a fraud upon Howell, Limited, and not upon Mr. J. C. Howell, who was suing in his own name. There had been no notice given to the defendants of any assignments, but that was necessary in order to entitle Mr. Howell to sue. In an action for deceit there must be a false allegation as to an existing fact, and he contended that such a statement was never made by the directors to Mr. Howell, that there were no debentures. But suppose it had, it appeared from the evidence it was true in substance, and therefore there could be no ground for an action for deceit.

Mr. Abel Thomas submitted the same points, emphasising the second one, stating that after the admissions made by Mr. Howell as to the limited company, there could be no action.

Mr. Bankes contended that there was one cause of action, by fraud upon the limited company upon August 28th, 1894.

The Judge replied that that would be if he allowed an amendment. Therefore, the whole matter depended on whether or not the plaintiff could be allowed to appear as Howell, Limited, and if he did not allow the amendment, the whole case would go by the board. If he acted otherwise, it would be open to plaintiff to bring another action. Everything had been brought out and thrashed out, and he thought it best to take the verdict of the jury.

Mr. Williams said he was quite willing to take the verdict of the jury, but he took the point that there could not have been fraud upon both—it must have been upon the limited company or upon Mr. Howell individually. Mr. Howell sued individually, and he (Mr. Williams) held that he could not succeed.

The Judge agreed.

Mr. Williams said allegations of fraud had been unwarrantably made, and he could not help thinking that his friend, Mr. Bankes, must have known there was no case.

After further argument, Mr. Bankes contended that Mr. Howell had a right to bring an action.

The Judge: I think, in the interest of all parties, I shall allow the case to go to the jury.

Mr. Williams: You say that there was an assignment, and that Mr. Howell was the assignee. I submit that no notice of it was given.

The Judge: I shall allow the case to go to the jury.

Mr. Williams: Well, I think there is no cause of action. He then addressed the jury, saying that the gross charges of fraud made against the defendants were untrue in substance and in fact, and he he had to complain of the reckless way in which those charges of fraud had been hurled at the heads of Mr. Randall and Mr. Pritchard. He confidently asked the jury to say that the charges had not been substantiated, and that the defendants were not liable for the debt claimed.

Mr. Abel Thomas argued that there had been no concealment as to the formation of the new colliery company, as to their position, and as to the getting of debentures. It was an every day experience for a limited company, if they thought desirable, to issue debentures soon after goods had been supplied. The only foundation for a charge of fraud arose out of what took place on August 28th, 1894, but it was a question as to whose version of the case the jury could rely on. It was for the plaintiff to show that he had proved fraud, and if the jury were not satisfied that he had, it would be their duty to say that the plaintiff had not proved his case. He thought it was rather hard under the circumstances that such charges should be made against such gentlemen, and in the position of, and character of, Mr. Randall and Mr. Pritchard. He asked the jury to say that the case was a got-up one, got up at the last moment, and that the charge of fraud was unfounded.

Mr. Bankes, replying, said that the crucial point was, what took place at the interview on August 28th, 1894, and what was said to Mr. Howell then. Mr. Howell had asked if there were any charges on the property and if there were any debentures, and Mr. Howell had said in evidence that both Mr. Randall and Mr. Pritchard said there were none, but that Mr. Pritchard said there were dead rents which they would not enforce against the plant. Would the jury believe, that if the truth had been told at the interview, the defendants would have got a contract with anybody? The question was whether the statements made to Mr. Howell were made with the intention of defrauding him. Then why did the defendant company choose the same name. They said it was done in deference to the advice of their counsel. It might be said that sort of thing was very common, but it was sometimes done with the object of keeping creditors in the dark. He contended that there had been deliberate concealment from Mr. Howell as to the date of the debentures. But for the plant supplied, the defendants would have lost more, because the plant had been sold, and what they got for it went into their pockets. They would have lost more, but for the contract they had made with the plaintiff. There was £1,500 still unpaid to the plaintiff, and that was the amount of damage sustained by him through the fraudulent misrepresentation of the defendants. He, therefore, asked the jury to give a verdict in plaintiff's favour.

The Judge, in summing up, said he thought it best to have the verdict of the jury, because had he stopped the case, the whole of the time spent on the proceedings would have been wasted, and plaintiff, as Howell, Limited, would have been able to bring another action, so that the issue would have to be fought out again on the same evidence. He thought the jury should give a verdict, assuming that their decision would put an end to the litigation. The charge, being one of fraud, was a very serious one, and he strongly asserted that no one should bring such a charge unless he was prepared to substantiate it, because it was akin to a criminal offence. It was the duty of the plaintiff to declare in distinct terms the fraud complained of. No one would part with money or goods if he had known at the time what he found out afterwards. This was probably something like the case here, but all the same, it was not fraud, as in this country everything practically was dependent on credit—in his opinion, very much more than it ought to be. People ran great risks in selling their goods because competition was keen and tradesmen were anxious to obtain orders and supply goods, often in a most foolish way. From the statement of claim and other documents, he had found it difficult to discover any evidence of fraud. It had been argued that defendants had said to plaintiff that there were no debentures. But there were no debentures, so there could not have been any fraud. He had never heard of concealment in a matter of this kind being a fraudulent representation, because there had been no representation at all. It was further alleged that defendants had concealed that the colliery company with which the contract was made had gone into liquidation and that a new company had been formed. A good deal had been made of the fact that the defendants had changed the company into another one, but was not the plaintiff's position very much the same? Undoubtedly, the main charge against the defendants was, that they covered up their liability by forming themselves into a company, and in that way prevented plaintiff from obtaining his money. Personally, he had a strong feeling against anything of that kind, and was always glad to unearth any fraud committed through the intervention of a company. He thought plaintiff had been treated badly in this case. The machinery had been obtained, and the plaintiff had not been paid as he should have been, but it did not follow that the defendants had been guilty of direct fraud. He thought the law of limited liability had gone too far. It was no good praying for it, it was past praying for. Efforts had been made to limit the powers of limited companies materially, and he was sorry that these had not succeeded. They had to deal with the law as it stood, and according to the evidence, it was clear that Mr. Howell knew all about the working of limited companies and ought to have been on his guard against the defendant company, or any other company that might have obtained his contract. He could not find that there had been either fraud or suppression of facts.

The jury after a brief consultation, returned a verdict for defendants, and judgment was entered accordingly, with costs on the higher scale.

Donnison, Berlyn & Co. *v.* Lord Charles Beresford.

In the Queen's Bench Division, on Tuesday, before Mr. Justice Mathew and a special jury, the case was heard of Donnison & Co. *v.* Beresford. This was an action brought by Messrs. Frederick A. Donnison, Berlyn & Co., electrical engineers of Great Portland Street, against Lord Charles Beresford, to recover £140 6s. 2d., the balance of an account alleged to be due to the plaintiffs for fitting up the defendant's house with an electric light installation. The defence was, that in various respects the work was carelessly and negligently done, that certain charges were excessive, that certain other charges were included in the specification, and were not, therefore, properly chargeable again. There was also a counter-claim by the defendant for the account of another electrical engineer who had been called in to make good the defects of the plaintiffs' work. The plaintiffs, in answer to this, denied that there were any such defects in their work.

Mr. Herbert Reed, Q.C., and Mr. Hollams were counsel for the plaintiffs, while Mr. Lawson Walton, Q.C., M.P., and Mr. J. Eldon Bankes represented the defendant.

Mr. Reed, in opening the case, said the action was brought by the plaintiffs to recover the balance of an account for electrical work done to 2, Lower Berkeley Street, the residence of the defendant. The case, having regard to the defence set up, was of extreme importance to the plaintiffs, who were well-known electrical engineers, carrying on their business in London. The defendant had thought fit to charge that the work the plaintiffs did had been done in an improper and dangerous manner. The issues were of importance, as not only a question of pounds, shillings and pence was involved, but a charge was made against the plaintiffs that the work they had been engaged to do was improperly done. In September of last year it appeared that Lord Charles Beresford was desirous of having his house fitted with the electric light. He was brought into communication with the plaintiffs, and on September 28th they sent in a specification for the supply of 110 lights at 9d points for an agreed price of £94. The plaintiffs secured the order, and they began work early in October. As they proceeded Lady Beresford suggested various alterations outside the specification, and these having been made, brought the bill up to a great deal more than the original estimate. The result was that the work was not completed until some time in the month of December. All the time that the work was going on there were builders in the house doing things here and there, and also another person named Mr. Rorke, who, he believed, was an electrical engineer, and who was himself doing a good deal of electrical work in the house, Lady Beresford having the right under the specification to buy her own fittings, the plaintiffs' duty being to fix the fittings so bought. In some cases the fittings were actually set up by Mr. Rorke, who also, in some instances, altered the original work done by the plaintiffs. The work was practically completed early in December, and on the 2nd of that month arrangements were made by the defendant with the electric supply company having the control of that particular district to have a thorough test of the electric light installation, and the current turned on. The result was highly satisfactory. Nothing more was heard of the matter until March 1st, 1897. The plaintiffs' bill, in consequence of the various alterations they had had to make at the request of Lady Charles Beresford, came to £240, and two cheques of £50 each had been received on account. In the interval the plaintiffs had written on two occasions for further payments, but had got no acknowledgment until March 1st, 1897, when a letter was received from Lord Charles Beresford's private secretary, saying that the defendant's solicitors had the matter in hand. On the same date the solicitors, Messrs. Ellis & Ellis, wrote to plaintiffs:—"Gentlemen, Lord Charles Beresford's private secre-

tary has, in the absence of his lordship, consulted us with reference to the work done by you under contract at 2, Lower Berkeley Street. Having obtained written reports from two consulting electrical engineers, we can come to no other conclusion than that the work done by you is not in accordance with your contract; that it was, in the state in which you left it, highly dangerous; that it will cost a good deal of money to put the work in the state in which it should have been left by you, and it would not be advisable, or indeed safe, to allow you to rectify or complete the work which was entrusted to you. Under these circumstances we have advised that the work should be put into the hands of some competent person, and that Lord Charles Beresford should deduct from the amount claimed by you the expense to which he will be put." The work, the letter proceeded to state, was now being set right under the supervision of one of the two consulting electrical engineers who had inspected and reported upon the installation, and if the plaintiffs desired to see its present condition, arrangements could be made for their doing so. This, said counsel, was the first intimation that had ever been conveyed to the plaintiffs that there was the slightest complaint to be found with their work, and they were then told in effect that they would not be allowed to set it right, but that somebody else must do it because they were not competent. Of course that was a very serious stigma to cast upon the plaintiffs, and on March 2nd they wrote asking for leave to inspect the work. On that same day Mr. Donnison, a member of the plaintiffs' firm, accompanied by his foreman, Mr. Lowry, and Mr. Walton, an engineer of the Metropolitan Electric Supply Company, went and made an inspection. They found that a great deal of the work that had been done by the plaintiffs had been altered since they had completed it, that fittings had been replaced, and various alterations made. No complaint was then made of the plaintiffs' work, and no defect of any real importance was pointed out to them, nor anything which could give rise to danger. The matter between the parties could not be arranged, and ultimately the present action was brought.

Evidence was then called in support of the plaintiffs' case.

Mr. Frederick A. Donnison, member of the plaintiff firm, stated that it was in September, 1896, his firm was approached as to lighting Lord Charles Beresford's house, and on the 28th they sent in a specification for wiring, supplying switches and cut-outs, but not including new fittings. There were to be 110 lights, and the whole work was to be carried out in a proper and workmanlike manner. The operations were commenced about October 6th, and by December 2nd they were sufficiently advanced to have the current supplied by the Metropolitan Electric Supply Company. Mr. Barker, the inspector of that company, attended and examined the work, certifying that it had been properly done. By the end of the year witness's workmen had finished the wiring, and while they were there witness was himself frequently at the house. On many occasions, at the suggestion of Lady Charles Beresford, alterations were made in the position of the fittings, the lights being placed in a situation other than that originally selected. This entailed much extra labour. A Mr. Rorke, an electrical engineer, was present while the firm's workmen were engaged. Two cheques on account, of £50 each, were received from the defendant, and then on March 1st plaintiffs received a letter from Mr. Macdonald, Lord Charles Beresford's private secretary, stating that the account had been sent to the defendant's solicitors. This was followed by a letter from Messrs. Ellis & Ellis, the solicitors, which had already been read by Mr. Reed. On March 2nd, witness went to inspect the work with his foreman, Mr. Lowry, and Mr. Walton, the engineer of the Metropolitan Supply Company. When they arrived there, they found Mr. Rorke and a Mr. de Segundo present on behalf of the defendant. They were taken into Lady Charles Beresford's bedroom, where the lining had been stripped, and there they were pointed to a nail which had inadvertently been left in the casing by one of the workmen. It did not touch or interfere with the wires, or affect the installation in any way, and could not possibly cause any danger. Outside the bedroom he was shown the distribution board, or rather the place where the distribution board had been, and a complaint was made that the wires had been bunched there, and that consequently there was danger. There was some bunching, but there was certainly no danger. The system adopted was that of sectional services, and bunching was inevitable. No objection was taken to "bunching" by the London County Council, or any other authority. The distribution boards had been removed, so that it was impossible at that time to see how they had been fixed. In Lord Charles Beresford's study witness was shown four brackets, of which complaint was made that joints had not been soldered. As a matter of fact, the plaintiffs had only put up two joints, and Mr. Rorke admitted that he himself had put up the other two. The joints were what were known as dry joints. Originally all the joints had been soldered, but so many alterations were suggested by Lady Charles Beresford, that it would have been impossible to have continued soldering the joints, as the wires would have to be cut at each subsequent alteration. It was in these circumstances that the dry joints were used, and there was no danger arising from them. In other cases dry jointing had been similarly used for the same reason. No further complaint was made, but some other work which had been done by the plaintiffs was, on examination, found to be perfectly correct. The workmen who were employed to do the job were thoroughly competent, and did their business in a proper manner in every respect. The charges which were made outside the specification for wiring were reasonable and proper, and were the ordinary charges.

In cross-examination by Mr. Walton, Witness said that when the final position of the brackets was decided upon, they should be soldered, and not left dry jointed. If witness's firm had been left to complete the work, the joints would have been soldered; but when they had finished, it had not been decided where the joints were to be fixed. There was no danger from these joints being left dry, and it was not even necessary that they should have been soldered, as they were so well made that, without soldering, there could be no danger. He was aware that the Phœnix Fire Insurance Office, in their rules, required that in the case of insurance policies effected with them, all the joints in connection with an electric light installation should be soldered. The brackets in this case, however, were temporary. They had been at first fixed as permanent, and were then soldered; but as Lady Charles Beresford was repeatedly having them removed, it became impossible to solder them until their final position was decided upon. When witness's firm had finished, they left another contractor, Mr. Rorke, in the house, and it would be his duty to solder the joints when their place had been determind with finality. As to the question of bunching, he admitted that there was some bunching at certain points; but this was inevitable, and did not prevent the installation being both carefully carried out and perfectly safe. The numbering of the fuses, &c., was a matter which was always left till the completion of an installation, and by an oversight it had been omitted in this case. The omission, however, could be rectified in something like two hours.

Mr. Horace Edward Barker, an inspector in the employment of the Metropolitan Electric Supply Company, deposed to making a test examination of the installation at Lord Charles Beresford's house on December 2nd, 1896. This test was for the purpose of ascertaining whether the installation was safe for the application of a current of electricity. He made a certificate on the occasion, in which he stated that the character of the work was good. Had there been any defect in the wires of any moment the test could not have been as satisfactory as it was nor have given anything like the same results. He saw the bunching which had been referred to, and stated that he frequently saw similar instances of it. No danger could arise from it. He saw no overloading at the circuits at the time of his inspection. He saw certain dry joints. There was no real danger from temporary dry joints if the wire was properly insulated. From his examination he was satisfied with the installation and passed it.

Cross-examined by Mr. Walton: The test which his company applied in the case of installations was what was known as a pressure test. There were many defects which could not be detected by it; such, for instance, as want of casing, the crossing of wires, and dry joints. It was to the interest of his company to have as many users of the electric light as possible, but, if he were aware of it, he certainly would not, under any circumstances, pass an installation that was at all dangerous, or that was likely to be so in the future.

Mr. Lowry, managing foreman to the plaintiff company, stated that the men employed to do the work at the defendant's house were experienced and competent workmen. When the work was completed there were four or five dry joints left. This was in consequence of Lady Charles Beresford having so frequently changed the position of the brackets, that it was considered unadvisable to again solder them until they were to be finally fixed. They had been soldered in the first instance. He was not aware of any of the circuits crossing, and there was no "bunching" except such as was absolutely necessary under the system adopted by the plaintiffs. At the date plaintiffs' workmen left the house there was no overloading at any of the circuits.

At this stage the Court adjourned.

The Sheffield Corporation and Electric Lighting.

In the Chancery Division, on Saturday, before Mr. Justice North, the action was heard of the Sheffield Corporation *v.* the Sheffield Electric Light and Power Company, Limited. The plaintiff claimed to enforce specific performance of a statutory contract for the sale to them of the undertaking of the defendants, payment for which was to be made by the issue or transfer of Sheffield Corporation stock sufficient to provide a 5 per cent. annuity upon the capital sum expended on the undertaking. The defendants contended that the payment was to be made by the issue of irredeemable stock, and that by an Act passed in 1892, the Corporation had no power to issue such stock. In answer, the plaintiffs said that prior to June 27th, 1892, the day on which the Electric Lighting Confirmation (No. 4) Act received the Royal Assent, the Corporation had express power under the Sheffield Corporation Act, 1883, to issue irredeemable stock, but by the provisional order altering the Sheffield Corporation Act, which also received the Royal Assent on June 27th, it was provided that so much of the Sheffield Corporation's Act as conferred upon the Corporation the power to create and issue irredeemable stock should be repealed. The plaintiffs contended that the stock referred to in the Sheffield Electric Lighting Order, 1892, was redeemable stock, but in the alternative they submitted that, notwithstanding the provisional order altering the Sheffield Corporation's Act, they had power to issue irredeemable stock for the purposes of this particular contract.

Mr. Swinfen Eady, Q.C., Mr. Ingle Joyce and Mr. Parker appeared for the Corporation, and Mr. Cripps, Q.C., Mr. Cozens Hardy, Q.C., and Mr. Theobald represented the defendants.

His Lordship gave judgment on Monday. He said that the issue to the defendants of redeemable stock would mean that they would have to accept an annuity of 5 per cent. for a longer or shorter period as the case might be, and that then it would cease. Could that be the meaning of the provisional order? He did not think it could. What was pointed to was an annuity of 5 per cent., which was to be a continuing annuity, and not an annuity redeemable, say, at the end of five years. Therefore, what they were bound to issue was irredeemable stock, though, of course, under the Act. it was always open to them to agree with the undertakers whether it was to be redeemable or irredeemable. They could not, however, redeem compulsorily. Well then, this further complication came in. On the same day on which the Act authorising the purchase received the Royal Assent—that was on June 27th, 1892, and the Act also received the Royal Assent, which so altered the Sheffield Corporation Act of 1883,

as to repeal their right to issue irredeemable stock. The question was discussed as to which of these two Acts had precedence, but he thought the difficulty thus started did not arise, because it was settled by the Acts themselves. The one order came into effect on the day upon which the Act confirming the order was passed, and the other order provided that it should have effect "from and after the date of the Act of Parliament confirming the order." The distinction was a clear one, for it had been laid down that "from and after the date" meant the day after the date on which the Act was passed. Therefore, when the provisional order authorising the purchase came into operation the Corporation were still in a position to issue both redeemable and irredeemable stock, though no doubt on the following day that power came to an end. In this way the difficulty had arisen in considering what the effect of the statutory contract was. In his opinion, then, the Corporation would have to issue irredeemable stock to comply with the terms of the contract, but that on the day following the order they had no longer power to do so. It was urged on behalf of the plaintiffs that the two orders must be read together, and that the repealing order must be taken as implying an exception, so far as it was necessary, to comply with the terms of the contract. He could not assent to that argument. The provisional orders were perfectly clear. He had not been referred to anything that modified or qualified the express provisions of the order that the right to issue irredeemable stock should be repealed. He had looked at recent decisions in the House of Lords in the case of the West Derby Union as throwing some light upon the mode in which one must deal with a matter of this kind, and he thought he should be acting contrary to the principles laid down in that case if he were to say that it was intended that the express provisions of the Act were to bear implied qualifications. He could not find anything containing an implied continuing power to issue irredeemable stock. It was urged that the two Acts were inconsistent, but it was impossible for him to modify one by the other. The conclusion he came to, was that the contract could only be performed by the Corporation by issuing or transferring irredeemable stock. The action was one for specific performance, but he was not disposed to deal with that part of the case at present, as if a mistake had been made, the Local Government Board had power to correct it by authorising the issue of irredeemable stock in the future to such an extent as was necessary to give effect to this contract.

Mr. Cozens Hardy asked that the action should be dismissed. There would have to be fresh legislation by the Corporation, and until that event happened they were precluded by his Lordship's decision from performing their part of the contract.

Mr. Justice North did not see why a fresh notice to the electric company was necessary, but, if so, the action must be dismissed.

After some further discussion, his Lordship ordered, "The Court being of opinion that the Corporation's stock, which, according to the true construction of the Act, is to be issued to the defendant company, is irredeemable stock, the action is dismissed, but without prejudice to any action which the Corporation may be advised to bring to enforce such contract, if they are able at a future time to issue irredeemable stock."

Walburg, Dymond & Co. *v.* W. V. Scott & Co., Limited.

In the Chancery Division on Friday, December 3rd, before Mr. Justice Romer, the case of Walburg, Dymond & Co. *v.* Walter V. Scott & Co., Limited, came on for hearing as a motion by the plaintiffs, who carry on business at Mansion House Chambers, for an injunction to restrain the defendants from representing, by circulars, that they are carrying on the business of Crompton & Co., Limited, of Mansion House Buildings, so far as it related to what was called wiring electric lights.

Mr. Levett, Q.C., and Mr. Cann appeared for the plaintiffs; and Mr. Neville, Q.C., and Mr. Pridham Wippell for the defendants.

Mr. Levett said the plaintiffs had bought this particular branch of Crompton's business, and the defendant, Scott, who was in the employ of Crompton, had started business for himself, and he was representing that he was continuing to carry on this particular branch of Crompton's business, which the plaintiffs had purchased from Messrs. Crompton.

Mr. Neville said that Mr. Scott, who carried on business at Earl's Court, was far from desirous of doing anything which the Court would think wrong, and when complaint was made by the plaintiffs he immediately expressed his willingness not to represent that he was carrying on Crompton's business. He was quite ready to meet the plaintiffs, and he was prepared to give an undertaking until the trial of the action not to further issue the circulars complained of. He, however, legitimately desired to make as much as he could of his connection with Crompton's, but he did not desire to do anything which would lead to the belief that he was carrying on their business.

Eventually, upon his Lordship's suggestion, an order was agreed upon, under which the defendants undertook, until the trial of the action, not to further issue certain of the circulars complained of, or any circulars calculated to lead to the belief that the defendants were continuing to carry on the particular branch of Crompton's business now carried on by the plaintiffs.

Nathan *v.* Smith.

In the Chancery Court of Lancashire, on Friday last, before Vice-Chancellor Hall, Charles Nathan, tailor, of 34, Islington, Liverpool, applied for an injunction to abate a noise against George Smith, manufacturer of gas meter fittings, of 18, Fraser Street, Liverpool. It appeared that the premises in question adjoin each other, and the allegation was that the working of an electrical motor by the defendant created such a noise that it was prejudicial to the health of Mrs. Nathan, and Mrs. Waller who also lived in the plaintiff's house. For the defence, evidence was called to show that the noise from the motor had not increased in the least degree during the time complained of, that the noise objected to was from the streets, or from lathes in the workshop, and that there was no noise that could possibly be a nuisance to the plaintiff or his family, or likely to affect the people in the adjoining premises.

His Honour in giving judgment, said the motor had been in use since October, 1893, and he was satisfied that there had been no alteration latterly in the mode of working it, or in the noise made by its working. He believed that a noise was heard in the plaintiff's parlour, but the motor, although it made some noise, could not possibly make such a noise as would interfere with health. He believed the case had been exaggerated. The true cause of complaint was probably the noise made by a tooth-cutting machine fixed close to the party wall, and occasionally worked, but the present complaint was against the motor, and therefore the action would be dismissed with costs.

Upon the suggestion of His Honour, the defendant said he would remove the tooth-cutting machine to avoid any further complaint.

The "D.P." Battery Company *v.* Scott Anderson.

This was an action in the Westminster County Court on Wednesday to recover a balance of account for work done and goods supplied to the order of defendant, of Sheffield.

Mr. Mallinson, counsel for the company, said his case rested on the correspondence, which he read, to the effect that the company's works were at Charlton, and the work was done for defendant in Somerset. The company estimated £385 for the supply and erection of electrical instruments, and defendant had paid £200 odd. A claim for £25, part of the work, defendant said was agreed at £18, and that sum was now claimed. There was also £6 10s. for carriage of empties, £3 18s. for glass covers, not in the estimate; £1 12s. for connectors, and £1 11s. for seven broken carboys, in which acid was supplied.

Defendant said the order was dated June, 1896, and was for a complete battery, to be erected on wooden stands, for £385, less 10 per cent., which he had paid, and the company now wanted to be paid for extras. He admitted the item of £1 12s. for connectors.

Counsel for the plaintiff went through the tenders, and contended there was nothing in them agreeing to include the items of the claim in the lump sum of £385.

His Honour gave the company judgment for £27, knocking off the £1 11s. for carboys broken.

Rashleigh Phipps & Co. *v.* Dean.

This case came before his Honour Judge Lumley Smith, Q.C., in the Westminster County Court, on Monday, by way of an application to set aside a committal order against defendant. Plaintiffs were Messrs. Rashleigh Phipps & Co., electrical engineers, of 102, Oxford Street. W., and defendant, H. C. Dean, a gentleman residing at 26, Old Bond Street, W. The committal was for the non-payment of £24 18s. 6d., which arose through plaintiffs fitting up a hygienic and hair specialist's premises at defendant's address with electric light. The grounds of the application were, that the judgment summons was not served, and had it been, defendant would have appeared and satisfied the Court he was unable to pay.

His Honour ordered payment at the rate of 10s. a month for three months, then £1 a month for three months, and £2 a month afterwards.

BUSINESS NOTICES, &c.

Ambroin.—Messrs. Estler Brothers, of 27, Leadenhall Street, E.C., have been appointed sole agents for this country for the Ambroin insulating material.

Annual Supper.—The factory department of the British Thomson-Houston Company, Limited, held their first annual supper on Saturday last (December 4th) at the Pelican Hotel, Mr. R. W. Woof in the chair. The technical department was represented by Mr. H. M. Hobart. After supper "The Success of the Company," coupled with the name of Mr. H. F. Parshall, was drunk with enthusiasm.

Elmores.—A petition was presented to the High Court of Justice on November 19th by Elmore's German and Austro-Hungarian Metal Company, for the purpose of confirming a special resolution reducing the capital of the company from £250,000, divided into 50,000 preference shares of £2 each, and 75,000 ordinary shares of £2 each, to £162,981, divided into 50,000 preference shares of £2 each, and 62,981 ordinary shares of £1 each, by cancelling capital which has been lost, or is unrepresented by available assets in the following proportions, namely:—by cancelling 1,682 ordinary shares which have been forfeited, and 10,337 ordinary shares which have been surrendered to, or for the benefit of, the company, and by cancelling paid up capital to the amount of £1 per share upon each of the remaining 62,981 ordinary shares, and by reducing the nominal amount of the said ordinary shares from £2 to £1 each. The petition is to be heard before his Lordship, Mr. Justice Wright, at the Royal Courts of Justice, Strand, London, on Tuesday, December 14th, 1897. Any creditor or shareholder desiring to oppose should appear then.

Electrical Wares Exported.

Week Ending Dec. 7th, 1896.	£	s.
Adelaide	61	0
Albany	705	0
Alexandria. Teleg. mat.	159	0
Amsterdam	120	0
„ Teleg. mat.	492	0
Barcelona	100	0
Bombay	14	0
Boulogne	6	0
Brisbane. Telephone...	60	0
Brussels	22	0
Buenos Ayres	157	0
Calcutta	462	0
„ Teleg. mat. ...	78	0
Cape Town	1,013	0
„ Telg. mat....	3,482	0
Colombo	55	0
Copenhagen. Teleg. wire	25	0
„ Teleg. mat.	42	0
Delagoa Bay	69	0
Durban	946	0
East London	644	0
„ Teleg mat.	3,664	0
Gothenburg	180	0
„ Teleg. wire	214	0
Kilimdini. Teleg. mat.	350	0
Le Treport	11	0
Lyttleton	140	0
Madras	7	0
Madeira. Teleg. mat...	120	0
Melbourne	106	0
„ Teleg. mat ...	17	0
Nagasaki. Teleg. mat.	1,580	0
North Atlantic. Teleg. cable	2,040	0
Port Elizabeth	74	0
„ Teleg. mat.	1,056	0
Rio Janeiro	17	0
Rotterdam. Teleg. mat.	14	0
Shanghai. Teleg. mat.	27	0
Singapore	16	0
„ Teleg. mat....	65	0
Sydney	418	0
„ Teleg. mat. ...	345	0
Trinidad	11	0
Wellington	325	0
Yokohama	17	0
Total	£19,727	0

Week Ending Dec. 7th, 1897.	£	s.
Alexandria. Teleg. mat.	85	0
Amsterdam	126	0
Bombay	111	0
„ Teleph. mat. ..	80	0
Buenos Ayres	11	0
Calcutta	102	0
Cape Town	472	0
Clinde	1,060	0
Colombo	60	0
Copenhagen	22	0
Delagoa Bay	163	0
Durban	1,128	0
Fremantle	28	0
Gibraltar. Electric cable	1,800	0
Gothenburg	452	0
Halifax. Electric cable	4,500	0
Hamburg	10	0
Hong Kong	40	0
La Plata. Teleg. mat.	143	0
Launceston	595	0
Lyttleton	45	0
Madras	50	0
Melbourne	65	0
Monte Video	22	0
North Sea. Teleg. cable	1,661	0
Port Elizabeth	32	0
Port Said	48	0
Rio Janeiro	24	0
Rosario	17	0
Santa Cruz	10	0
Shanghai	96	0
„ Teleg. cable	140	0
Singapore. Telephone	114	0
Stockholm. Teleg. wire	441	0
Sydney	1,883	0
Wellington	20	0
Yokohama. Teleg. mat.	52	0
Total	£15,708	0

Foreign Goods Transhipped.

	£	s.
Wellington. Teleph. mat.	2,574	0

Enclosed Arc Lamps.—The expected litigation in America with reference to the enclosed arc lamp patents has been avoided by acknowledgment of the Marks patents by several of the leading manufacturers. We understand that licenses have been taken out by the Manhattan Company and the Bergmann Company, and that the General Electric Company have decided to do the same. It will be remembered that the Marks patents in this country were purchased by the Jandus Arc Lamp and Electric Company, who have already granted licenses to a number of the principal manufacturers, amongst others the General Electric Company, who are selling the Bergmann lamp in England.

Heath, Snoxell & Co., Limited.—This company of Apollo Ironworks, Blews Street, Birmingham, have purchased the business of Messrs. W. H. Heath & Co., of Birmingham, and we have before us a catalogue of their electric motors and dynamos for electric lighting, power, and electro-deposition work. The list is excellently printed and illustrated. Tabulated and general particulars are given of continuous current dynamos of the "Standard" type, continuous current motors, and electroplating dynamos and measuring instruments are also briefly noted.

National Cycle Show.—At Messrs. R. Lloyd & Co.'s stand at this show (No. 76), the new patent friction transmitter of the Unbreakable Pulley and Mill Gearing Company is exhibited.

New Business.—We understand that Messrs. Hill and Gifkins, until very recently in the employ of Messrs. Drake and Gorham, have started business as electrical contractors, under the style of Messrs. Hill, Gifkins & Co.

"Security Universal" Wiring.—Messrs. J. D. F. Andrews & Co., Limited, of Fulham, are issuing a list setting forth the merits of the above system (Andrews' patent) for electric light and power. In this system the wiring is self-contained in metal, wood casing being abandoned, and it has been developed in the concentric, double, and conduit forms.

Smithfield Show.—Messrs. W. H. Wilcox & Co., Limited, were among the exhibitors at this show, which closed on 11th inst. They exhibited a collection of oils, packings, gauges, brass and steam fittings, the Penberthy injectors, semi-rotary pumps, hose, belting, &c.

Messrs. John Fowler & Co., (Leeds), Limited, exhibited various ploughing engines, traction engines, road locomotives, and various models of light railway plant and stock.

Staff Dinner.—On Saturday, 27th ult., the annual dinner of the staff connected with the North-Western Province took place at the Mosley Hotel, Manchester. Between 30 and 40 of the chief members of the staff were present, Mr. R H. Claxton, the provincial superintendent, presiding. A smoking concert followed the dinner.

South African Electrical Notes.—The December issue of the *British and South African Gazette* contains the following items:—An order for an additional 500 miles of telegraph wire for the Trans-Continental Telegraph Company has been placed in England.—The powerful electric pumping plant supplied to the Knight Central gold mine is by Gould, of New York. The pumps, which are 4½ inches by 8 inches dimension, are of American pattern, each being of a capacity equal to 35,000 gallons per hour. They are fixed in pairs in order to minimise delay in case of accidents.—An electric locomotive for surface haulage has been supplied to the Violet gold mine.—The Table Bay Harbour Board are meditating the acquisition of two electric cranes for the service of the port.—As foreshadowed by us some time ago, further orders for electric lighting plant are likely to be shortly called for by the Durban Town Council, the borough engineer having recommended further extensive additions to the new installation.—An electric plant is in course of erection at the Knight's Central Deep mine.—We understand an electric installation has been ordered for the Witwatersrand Deep gold mine.—Tenders were called for last month for the supply and installation of an electric lighting plant at the new asylum, Valkenberg, Mowbray, Cape Colony.—The new electric equipment at the De Beers mine has been supplied by the General Electric Company, of New York, and includes three tandem compound engines of 175 I.H.P., two 50-kw. six-pole compound dynamos of 220 volts and 115 volts respectively, a large switchboard furnished with voltmeters and ammeters, and 12,000 feet of large copper cable.—An electric lighting plant on the high tension alternating current system, the voltage being up to 2,000, with step-down transformers to reduce the pressure to 100 volts, is to be supplied to the Monarch mine, Rhodesia, through Messrs. Johnson & Fletcher, of Bulawayo.—The equipment of the Luipaard's Vlei mine includes two 50-unit four-pole continuous current dynamos of 440 volts, a 35 H.P. hauler, one of 15 H.P., and motors for cyanide plant, and fitters' and carpenters' shops. The lighting dynamo supplies 300 16-candle-power lamps. The installation is being supplied by Messrs. Easton, Anderson and Goolden, Limited, through Mr. F. W. Stokes, their Johannesburg representative.—Messrs. Crompton & Company, Limited, supplied the electric installation for the Violet gold mine.—The electrical installation of Moodie's mine, Barberton, providing power for 200 stamps, and costing over £30,000, was supplied by Messrs. Reunert & Lenz, Johannesburg. The same firm, so we understand, have several contracts in hand for electrical installations on Rhodesian account.—Two 165-H.P. General Electric Company's generators and a fine switchboard are portions of the electrical equipment of the Witwatersraad (Knight's) mine.—The electrical pumping plant furnished to the Knight's Central gold mine is of American make, and consists of a 550-volt dynamo, arranged on the three-phase system.

Wiring Contracts.—Messrs. W. Liley & Co., of Liverpool have lately carried out, or have at present in hand, contracts for installations as follows:—Star and Garter Hotel, St. John's Lane, Liverpool; Union Hotel, Parker Street, Liverpool; Assembly Rooms, Hardman Street; Messrs. Mowl & Morrison, Hardman Street; Messrs. Reece & Sons, Deane Street; Messrs. Miller & Co., Great Charlotte Street; Messrs. Ravenscroft & Son, Barnett Street; Mr. Whitty, Basnett Street; The Law Library, Cook Street; Mr. Hill, Mount Pleasant; Mr. Noblett, Moorfields; Messrs. Lloyd & Co., Ranelagh Street; Messrs. Bradford, Dale Street; Mr Cohen, Manchester Street; Messrs. McCarthy & Co., Redcross Street; Mrs. McFarline, Bedford Street; Messrs. Anderson Bros., Rose Street; Willaston Creamery Company, Willaston; Mr. Richardson, Chester.

ELECTRIC LIGHTING NOTES.

Bedford.—The Council last week decided to give notice to the Bedford Gas Company to discontinue, from July 1st, the public street lighting in another area; that tenders be obtained for the supply of a 250-unit combined plant; that tenders be invited for building offices and store-rooms at the Electricity Works; and that three transformers be purchased at an estimated cost of £200.

Bethnal Green.—The Vestry has appointed a special committee to look into the matter of electric lighting. The County of London and Brush Company is applying for a provisional order, and that fact led to the Vestry considering the matter.

Brighton.—The chairman of the Lighting Committee stated last week, that the new machinery that had just been completed enabled them to supply an additional 10,000 lamps. This would relieve the great pressure under which they had been working of late.

Burnley.—Tenders have been accepted for the supply and laying of electric cables for the Manchester Road extension, at £1,685.

Buxton.—Last Friday it was stated that Prof. Kennedy would be in Buxton during this week for the purpose of inspecting the town and reporting on electric lighting, and he was to be present at a ratepayers' meeting yesterday.

China.—A Chinese Syndicate proposes to establish a central electric lighting station at Hangkow in Che-Kiang, and also one at Honkow on the Upper Yangtze.

Colchester.—The Electric Construction Company recently informed the Electric Light Committee that the lighting of the town having been placed in other hands, they could not continue the installation at the Military Hospital, but they offered their portion of the plant at £119 6s. The consulting engineer's views on the matter are to be obtained. It had been resolved that in the event of Messrs. Siemens expressing willingness to undertake the temporary lighting, on similar terms to those existing with the Construction Company, their offer be accepted.

Conway.—The Mayor in laying a large scheme before the Council, thought they should consider the question of electric lighting for the town. If they did not do it themselves a private company would probably do it.

Darfield.—The London Parliamentary Agents applied to, informed the Council that the cost of obtaining a provisional order for lighting the township with electricity would be £375. The Council is inquiring why the cost should be so great.

Derby.—The Council has resolved that the salary of Mr. J. E. Stewart, the engineer at the central station, be increased from £312 to £362 per annum.

Dublin.—The Local Government Board inquiry into the proposed loan of £20,000 for electric lighting was to be held on the 8th inst. by Mr. C. P. Cotton.

Dundee.—Before the last Council meeting, a proposal of the Gas Committee was brought forward, to accept a tender of £315 for arc lamp pillars. This, however, was negatived by 16 votes to 12, as it was argued that the lamps would not be in position until the winter was nearly over, and by that time some decision might have been arrived at *re* electric traction, which would necessitate a re-arrangement of the lighting.

Edinburgh.—In further reference to the extensions to which we referred briefly last week, when this matter came before the Council, some interesting figures were given by Bailie Mackenzie in recommending the acceptance of offers for the supply of electric lighting plant at a cost of £20,059. He mentioned that when the plant now proposed was laid down, and in working order, as they hoped next September, the Dewar Place station would be complete, and would hold no more machinery. They would then have machinery equal to 7,780 horse-power, sufficient to supply 250,000 8-candle-power lamps wired; while the four new boilers now proposed would fill up the boiler-house with 17 boilers in all. As to the demand, he showed that for the respective periods from May 15th to November 27th, the applications, calculated at 8 candle-power lamps, had grown from 27,492 and 12 motors in 1895, and 28,439 and 28 motors in 1896, to 33,476 and 41 motors in the present year. The total joined on and applied for up till Saturday was equal to 148,032 8-candle-power lamps, including 90 motors of 200 horse-power. The continued increase was simply amazing, and so far as he knew, exceeded anything elsewhere. The output had increased in a similar fashion. The units sold for private lighting during the three periods above-mentioned amounted in 1895 to 196,160, in 1896 to 353,375, an increase of 80 per cent.; and in the present year to 687,340, an increase of 95 per cent. over 1896. The machinery and boilers they would have, with the addition of those now recommended, would carry them over the winter of 1898-99, but he did not think there would be nearly sufficient for the following winter. As they could do no more at Dewar Place, the committee agreed upon a site on the east side of M'Donald Road on the west side of the railway, opposite the new cable-power station. Much annoyance had been experienced through delay in supplying the machinery, and it had been thought desirable to make a change, and he would like the Council to authorise him to go to London and consult on the subject with Prof. Kennedy. It was decided that the matter, so far as concerned the purchase of machinery, should be recommitted, with power to Bailie Mackenzie to go to London and report, and the M'Donald Road site is to be secured.

Gloucester.—At last week's Council meeting considerable discussion took place upon the desirability of placing the electric power station and destructor works on the same site, and eventually it was decided to apply for a loan of £50,000, instead of £40,000 as recommended, in order to cover cost of site and destructor works. The Town Clerk stated that the engineer (Mr. Hammond) assured them that if tenders were at once obtained the electric light works might be got in operation before next winter. Tenders are now being invited.

Godalming.—The Local Government Board are about to hold a public enquiry on the subject of electric lighting.

Hampstead.—At the last Vestry meeting the electrical engineer, replying to a member, said that nearly the whole of the new plant ordered for the central electric lighting station had been delivered. It was hoped that the whole would be ready by last Saturday afternoon, and he was using every possible endeavour to get the whole of the machinery running this week. An assistant electrical engineer is being appointed in the place of Mr. Thomas Hesketh, resigned.

Hereford.—The Town Council is applying for a provisional order, and the Finance Committee will submit an estimate of the amount of capital required in connection with the undertaking.

Huyton and Roby.—The District Council held a special meeting last week to consider the electric lighting question. The Council recently took steps to apply for a provisional order, but it last week decided to abandon this, and endeavour to arrange terms with the British Insulated Wire Company with a view to compromise.

India.—The Lieutenant-Governor of Bengal formally inaugurated the electric light installation at Darjeeling, a large number of European and native residents being present The capital cost of the scheme, says an Indian exchange, including the expenditure likely to be incurred in supplying electricity to private houses on the terms of the agreement, and on constructing a house for the officer in charge of the machinery, will be Rs. 120,000, and the cost of maintaining the installation will be Rs. 9,000 a year.

Lancaster.—A supply of current is required for the Ripley Hospital, and the mains are to be extended for the purpose at a cost of £200.

Leeds.—There has been considerable delay in the Boar Lane and Briggate electric lighting scheme, but it is hoped the installation will be completed by Christmas.

Llandudno.—A Local Government Board inquiry was held recently into an application by the District Council for powers to borrow a sum of £25,000 for the erection of electric lighting works and the provision of a refuse destructor. Mr. A. H. Preece, the engineer, explained the details of the electric lighting works, which it was intended to erect near the present gasworks. The system to be adopted was that known as the three-wire system, and the scheme had been approved of by the Board of Trade. It was proposed to place 30 arc lights on the promenade, extending as far as Penrhyn Crossing, and 20 other arc lights in Mostyn Street and the streets crossing thence to the promenade, making 50 in all, each of 1,200 candle-power. The electric lighting portion of the scheme would cost £15,300, and £1,000 had been allowed for contingencies. Mr. Stephenson, the Council's engineer, explained the plans of the electric destructor, which would consume about 15 tons of refuse in 24 hours, the present average being about 30 tons per day. The estimate for the erection of this portion of the works was £8,591.

Maidstone.—The application of the Municipal Electric Light and Power Corporation for a provisional order is being opposed by the Council.

Newcastle.—The Deaf and Dumb Mission room is now lighted by electricity.

Perth.—Mr. Hawtayne last Saturday attended a meeting of the Police Commission and gave explanations regarding the report he had submitted on an electric lighting scheme for the borough. Without dust destructors the cost was estimated at £25,250, with dust destructors £2,700 more.

Provisional Order Transfers.—In last Friday's *London Gazette* are notices of the transfer of provisional orders as follows:—Electric lighting powers for Levenshulme to be transferred to the Manchester Corporation, electric lighting powers of the Moss Side District Council to be transferred to the Manchester Corporation.

Rawmarsh.—The District Council is to apply for a provisional order, and has decided upon a compulsory area.

South Shields.—During the last five weeks the total number of units sold was 12,466, as compared with 4,858 in the corresponding period of last year, or nearly three times as much.

Stranraer.—The premises of Mr. J. Hill, of Bridge Street, were lighted by electricity some days ago.

Swansea.—It is desired to light the new market electrically for Christmas, and a scheme which has been prepared shows the cost of the plant, including wiring and 24 2,000-C.P. lamps, at £576. The Swansea United Breweries offers to furnish current at 2d. per unit for a one, two, or three years' contract. A sub-committee is considering the matter.

Torquay.—The Town Hall and Bath Saloons are now being wired by Messrs. Massingham & Mann, and the same firm have also obtained the contract for wiring the supply station and other public buildings, besides upwards of four dozen shops, residences, &c. It is expected that current will be available early in the new year.

Turkey.—A foreign syndicate is reported to have applied to the authorities of the Vilayet of Aidin for a concession to light the town of Smyrna by electricity. The syndicate agrees to replace the existing gas lamps by a much larger number of electric lamps, to light gratuitously all the public establishments, and to hand over 10 per cent. of the net profits to the municipality.

Uddingston.—It is reported that steps are being taken with a view to forming an electric lighting company for the village. The suggestion is to utilise the falls or weir at Blantyre Mills.

Wallingford.—It is stated to be likely that the new workhouse buildings will be lighted electrically.

West Bromwich.—The Town Council last week discussed the proposed area for electric lighting. Powers are to be taken for the whole borough, but at first only a very limited number of streets will be supplied.

Weston-super-Mare.—A committee meeting of the whole Council was held last week to consider what modifications should be made in connection with Mr. W. C. C. Hawtayne's electric lighting scheme, No. 2, recently adopted by the Council. Mr. Hawtayne consulted with the Council, with the result that various modifications were made in connection with the scheme, reducing the estimated cost to £20,000. A motion to the effect that the Council be recommended to accept such modifications, was carried upon the casting vote of the chairman, eight members supporting the same and eight voting against. The Clerk will negotiate with the G.W.R. Co. in regard to site.

Whitechapel.—On Monday the District Board of Works decided to purchase land adjoining the destructor premises, estimated to cost £5,000, for the purpose of erecting an electric lighting station.

Worthing.—The Electric Lighting Committee approve of the proposed introduction of electric lighting into the borough, and are of opinion that the time has arrived when the Corporation should take the necessary steps to supply the town with the light. A sub-committee is preparing a report, embodying such recommendations as in their judgment should be adopted, and to obtain any information they may require.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—Major Cardew, R.E., of the Board of Trade, held an inquiry at Blackpool last week into the proposal of the Town Council to adopt the overhead trolley system of electrical working for the tramways, and to borrow £9,400.—Mr. R. C. Quin, the borough electrical engineer, said the scheme would save £1,500 a year. He did not consider that the overhead system was unsightly. Last year the trams were stopped for 32 days by drifting sand getting into the culverts.—Mr. John Lancaster, tramway manager, supported the scheme, and detailed the obstructions the present tramway system met with. When sand was blowing the cars could not run, and it took three days and nights to clear the culverts from the blown sand. When the system was stopped it meant a loss on revenue of £7 per hour per car in the season, and £1 in the winter.—Numerous witnesses for and against the scheme were examined, the inquiry being a very lengthy one.

Bournemouth.—The Town Council had before them in committee, on Wednesday, the different proposals to construct electric tramways through the town, and by a majority of two to one in a fairly full council, they rejected all the schemes.

Buenos Ayres.—La Capital Tramways Company, Limited, the first company to apply electricity practically to traction in Argentina, announces that 9¼ miles of their track in Buenos Ayres, being the Flores extension just constructed, and part of the old line lately converted from horse traction, were, with the power-house and equipment, have been officially inspected on behalf of the municipality, and were opened for traffic on the trolley system on 5th inst.

Bradford-Leeds.—The Leeds City Council will oppose this light railway scheme.

Cardiff.—The Parliamentary Committee last week fixed five years as the limit of time from the passing of the Act within which the proposed municipal electrical tramways shall be completed.

Dover.—The daily press records an accident which occurred in connection with the electric tramways in the High Street. Some overhead wire or other—it is not definitely stated what—gave way, and a man received a shock.

Dudley.—The Railway, Tramway and Electric Lighting Committee has sent a long letter to the Light Railway Commissioners, stating its objections to the proposed electric tramway scheme of the British Electric Traction Company. The Corporation has recently obtained a provisional electric lighting order, and the committee is advised that it is important for the success of that undertaking that they should find a customer to take electric power in the daytime. They looked to the tramways to do this. To permit a trading company to supply electric power within the borough would be very prejudicial to the interests of the town. The same committee recommended that the Corporation oppose the application of a provisional order by the Midland Electric Corporation for Power Distribution.

Dundee.—The shareholders of the Dundee and District Tramways Company last week unanimously approved the agreement for the municipalisation of the tramways.

Electric Omnibuses.—A *Financial News* correspondent says:—"The shareholders of the London Electric Omnibus Company may rest assured that, contrary to what Mr. William Marshall, the late deputy chairman of the company, has heard, the London General Omnibus Company has not entered into a contract to put 400 electric omnibuses on the streets. The Electric Omnibus Company, therefore, is not 'far behind that company,' as Mr. Marshall laments. But that is not to say it may not be. Although the London General Omnibus Company has placed no order for motor omnibuses, the thing may be done sooner than is expected. Propositions have been made, and various types of electric omnibuses have been offered to the company for some years past; and if nothing has been done, it is simply because nothing satisfactory has yet been submitted. Recognising the fact that the whole business of electric traction is in the experimental stage, the directors are content to wait."

Folkestone.—The Mayor presided over a meeting on Friday which approved of the general principles of the proposed electric tramways, and the Corporation decided to support the scheme.

Great Orme's Head.—A syndicate has been formed to promote the construction of an electric railway to the highest level of the Great Orme, and some days ago Mr. Enfield Taylor, engineer, Chester, attended a special meeting of the Llandudno District Council to submit plans of the proposed scheme. It is suggested that the line start from the site now occupied by the old Victoria Hotel, in Church Walks, and proceed along the road to St. Tudno Church, crossing some fields to the right of the church to a terminus not far from the old telegraph station and the Great Orme Lighthouse. The Council approved the scheme with only one dissentient.—Mr. Taylor said that the syndicate intended applying to Parliament for powers next session, and if obtained, the company would be formed at once.

Hartlepool.—The Hartlepool accident, when a horse was killed by coming in contact with a broken wire charged with electricity from the overhead wire of the tramway system, was the subject of an inquiry last week. The inquiry took place in the Hartlepool Council Chamber, and was held privately by Major Cardew on behalf of the Board of Trade.

Light Railway Schemes.—On November 30th the Light Railway Commission closed the books for receiving specifications for new light railways to be considered within the next three months, and an official list of those projectors of the new lines who had conformed to the rules, and had lodged their proposals in detail, has been published. The next step will be for the Commission to make inquiry specifically into each case, and visit the localities, and take technical and local evidence as to the desirability of the railways being constructed. There are 30 new projects—20 for England, six for Wales, and only two for Scotland. Sixteen railways are to be worked electrically; all the rest are steam, with the exception of one hydraulic.

The following is a list of the schemes which appeared in Wednesday's *Contract Journal*:—

England.—Amesbury, Wiltshire (London and South-Western, Amesbury Light Railway), 10¾ miles, steam power, 4 feet 8½ inches gauge; Bournemouth, Poole, 15 miles, electric power, 3 feet 6 inches; Bradford and Leeds (F. Beanland), 5½ miles, electric power, 4 feet 5½ inches; Brighton (British Electric Traction Company), 4¾ miles, electric power, 3 feet 6 inches; Central Essex (Light Railways Syndicate), 27½ miles, steam power, 4 feet 8½ inches; Christchurch and Poole (British Electric Traction Company), 13½ miles, electric power, 3 feet 6 inches; Cuckmere, Sussex (C. D. Gilbert), 8¾ miles, steam power, 4 feet 8½ inches; Finchley and Hendon, Middlesex (Finchley and Hendon Light Railways Company), 9 miles, electric power, 3 feet 6 inches; Folkestone and District (Folkestone District Electric Railways Company), 15½ miles, electric power, 4 feet 8½ inches; Grimsby and Saltfleetby (B. M. Kilby), 17½ miles, steam power, 4 feet 8½ inches; Hastings and Bexhill (Hastings, &c., Light Railway Company), 12½ miles, electric power, 3 feet 6 inches; Hastings and St. Leonards (British Electric Traction Company), 4 miles, electric power, 3 feet 6 inches); Isle of Axholme, Lincolnshire (J. Blaydes and others), 22 miles, steam power, 4 feet 8½ inches; Kinver, Staffordshire (E. Garcke and another), 4 miles, electric power, 3 feet 6 inches; Mid-Devon (J. Dickson and another), 14 miles, steam power, 4 feet 8½ inches; Middleton, Lancashire (British Electric Traction Company), 8½ miles, electric power, 4 feet 8½ inches; North Shields, Tynemouth, &c., (British Electric Traction Company), 2 miles, electric power, 3 feet; North Sunderland, Northumberland (North Sunderland Railway Company), 1½ miles, steam power, 4 feet 8½ inches; Potteries Extension (British Electric Traction Company), 4 miles, electric power, 4 feet; Rochester, Chatham, &c. (Rochester, &c., Electric Railways Company), 14½ miles, electric power, 4 feet 8½ inches; Sheppey, Kent (Light Railways Syndicate), 7¾ miles, steam power, 4 feet 8½ inches; Ventnor, Isle of Wight (E. Wetherick), 3½ furlongs, hydraulic power, 5 feet 9 inches.

Wales.—Abergavenny and Monmouth (J. R. Walford and others), 12 miles, steam power, 4 feet 8½ inches; Llanfair and Beaumaris (J. T. Firbank and others), 6½ miles, electric power, 2 feet 6 inches; Monmouth and Abergavenny (W. V. Pugh and others), 11¾ miles, steam power, 4 feet 8½ inches; Penarth and Cardiff (Cardiff, &c., Light Railway Company), 4 miles, electric power, 4 feet 8½ inches; Portmadoc, &c. (R. Davies and others), 11½ miles, steam power, 1 foot 11½ inches; Vale of Rheidol (Aberavon extension), Cardigan (Vale of Rheidol Light Railway Company), 16½ miles, steam power, 2 feet.

Scotland.—Bank Forth, Perth (J. Paton and others), 3 miles, steam power, 4 feet 8½ inches; Coatbridge and Airdrie, Lanark (British Electric Traction Company), 3 miles, electric power, 3 feet 6 inches.

Leeds.—The Thomson-Houston Company has accepted the offer of the Corporation for the purchase of seven of the cars recently used on the Roundhay Park line by that company. They are to be converted into horse cars.

Salisbury Plain.—The Light Railway Commissioners have decided in favour of the Great Western Railway Company's scheme for the construction of a line from Pewsey station to Salisbury, over the famous plain, and through the military camp which the War Office authorities intend forming there, and have submitted an authorised order for the same to the Board of Trade.

Manchester.—The City Council last week had before it the report of the special committee regarding the working of the tramways municipally and their operation by electricity on the overhead trolley system. The report was adopted after a long discussion. In introducing the matter, Mr. Alderman Milling gave notes of what would be an ideal form of traction for successfully operating the tramway service of a large commercial city like Manchester. The conditions which he named were, he held, reasonably fulfilled by the overhead system. Mr. Vaudrey moved an amendment, referring the matter back for several reasons. The opposition was replied to by Mr. Alderman Higginbottom, and when a vote was taken there were only two or three dissentients.

Sheffield.—The city surveyor has presented a report to the Tramways Committee on the best means of carrying out the reconstruction of the existing lines, and the construction of the extensions. The Tramways Committee has adopted the following recommendations of the Extensions Sub-committee:—1. That the conversion of the Tinsley and Nether Edge sections with the extensions through the centre of the city, in accordance with the resolution of the Council, be proceeded with without delay. 2. That the work of connecting the existing sections with the proposed central terminus at Fitzalan Square be commenced as soon as possible. 3. That the following extensions be proceeded with simultaneously with the work mentioned in the two preceding paragraphs, viz, Walkley, Pitsmoor, and Ecclesall Road. 4. That tenders be obtained from the British Thomson-Houston Company, Siemens Brothers, Dick, Kerr & Co., Davy Brothers, Limited, and the Electric Construction Company, Wolverhampton, for carrying out the work mentioned in paragraph 3, according to the specification to be prepared by the city surveyor and the resident electrical engineer. 5. That a resident electrical engineer be appointed to carry out the electrical equipment of the various lines and extensions mentioned in paragraphs 1 and 3, and that advertisements be issued inviting applications for the post, applicants to state their age, qualifications, experience, and salary required. 6. That the city surveyor, together with the resident electrical engineer, be empowered to appoint the necessary foreman, and employ such labour as may be necessary, so that the work may be completed as soon as practicable. Other resolutions of the Tramways Committee are as follows:—That the Council be recommended to authorise this committee to appoint the resident electrical engineer mentioned in the above report of the Extensions Sub-committee, without waiting for the confirmation by the Council of such appointment. That this committee be authorised to affix the Corporate common seal to the contract with the British Thomson-Houston Company, Limited, for the electrical equipment of the Nether Edge to Tinsley section, as soon as the terms thereof have been settled and agreed to. That Councillors Joseph Machin Furness, Robert Styring, Charles Hobson, and John Rutland Wheatley, be appointed a sub-committee to confer with a sub-committee of the Highway and Sewerage Committee with regard to the paving of the tramway routes. That in the opinion of this committee it is desirable that the street improvements rendered necessary by the reconstruction and extension of tramways in Sheffield be carried out under the supervision of this committee, exclusive of such as are at present being negotiated for or included in any scheme arranged by the Improvement Committee, and that with regard to these this committee act in conjunction with that committee. The Tramway Committee at their meeting on the 16th ult. further considered the motion of the Council, that the question of the acceptance of tenders of Messrs. Siemens Bros. & Co., Limited, and the British Thomson-Houston Company, Limited, for the electrical equipment of the Nether Edge to Tinsley section be referred back to the committee. The committee now recommend that the tender of the British Thomson-Houston Company, Limited, for the supply of the whole of the general plant and electrical equipment in connection with the Nether Edge to Tinsley section for the sum of £41,185 13s. be accepted.

The City Council on Wednesday confirmed the recommendation, and has entered into an exclusive contract with the British Thomson-Houston Company for the electrical equipment of the Nether Edge to Tinsley section.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Paramaribo-Cayenne ...	Oct. 25th, 1897 ...	Dec. 2nd, 1897.
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Otranto-Vallona	Oct. 11th, 1897 ...	...
San-Thomé-Loanda	Dec. 4th, 1897 ...	...
Pernambuco-Ceara	Nov. 24th, 1897 ...	Dec. 2nd, 1897.
Vigo-Borkum	Nov. 28th, 1897 ...	...
Sitia-Rhodes	Dec. 7th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 2nd, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

American Pacific Cable.—A Bill to lay a cable to Hawaii has been favourably reported on by the Commerce Committee of the House, and will be brought before Congress without delay. Survey of the route of the cable has been completed right to the island, and the Pacific Cable Company, of New York, which will be empowered to lay the line, expect to have it in working order by August next year.

Telegraph Construction Work in South America.—In a recent article the *Buenos Ayres Standard* says that six months previously Frigate Captain Leroux arrived at Puerto Madryn, after having made the long trip from the Rio Negro to Bahia Nueva on horseback, for the purpose of examining the route with reference to the construction of a military telegraph to Tierra del Fuego. "Having done all the prospecting necessary between Biedma and Puerto Madryn, the captain returned to Buenos Ayres to give an account of the work accomplished by him, and get any new instructions considered necessary before leaving for Puerto Deseado, this point marking the end of the section under his supervision, as from there to Tierra del Fuego Frigate Captain Funes is in charge. For some days Captain Leroux has been at Puerto Madryn, where he is preparing the expedition for Puerto Deseado in the territory of Santa Cruz. The section between the Rio Negro and Puerto Deseado is the longest and most difficult of access, as it consists of immense deserts completely without water, and there are no settlements where aid can be obtained when once the expedition has entered the region. Captain Leroux has met with all sorts of difficulties in organising his expedition, and is handicapped by his lack of authority to purchase horses; in fact, it looked at one time as though he would not be able to get animals for transportation, when Mr. Manuel Paz, an estanciero of the San José peninsula, came to his aid in a patriotic manner, and offered him sufficient horses, free of all charges. This he did simply from a desire to see the surrounding region developed and brought into easier communication with the older parts of the country. So the expedition will be off in a few days on its difficult if not dangerous journey. The poles for the new line have been landed at Puerto Madryn; but the inspectors report that they are of very poor quality, and if used will not last more than a year. It would seem to be very poor policy on the part of the Government to use such bad materials in constructing a line so difficult to repair, and it is probable that other poles will be obtained."

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—December 15th. The Corporation wants tenders for the supply and erection of boilers, pumps, economiser, &c., engines, generators, switchboards, accumulators, high and low tension cables, conduits, &c. See our "Official Notices," November 26th, for full particulars. Consulting engineers, Messrs. Kincaid, Waller & Manville.

Bedford.—January 10th, 1898. The Electric Light Committee want tenders for the supply and erection of a 420 B.H.P. double-acting compound enclosed engine, and a 250-unit alternator with stationary armature. See our "Official Notices" for particulars.

Bootle.—January 10th, 1898. The Corporation wants tenders for the supply and erection of boilers, engines, dynamos, switchboard, pumps, transformers, wiring, alteration of Town Hall wiring, batteries, mains, street boxes, and the running of the electricity works for three years. Consulting engineer, Mr. T. L. Miller, 7, Tower Buildings, Water Street, Liverpool. See our "Official Notices" for further particulars.

Canterbury.—December 20th. The Corporation Electric Lighting Committee is inviting tenders for the supply of Lancashire boilers, and boiler house plant, steam dynamos, condensers, &c., for the engine house, overhead travelling crane, switchboard, accumulators, mains, arc and incandescent lamps, meters, &c. Consulting engineer, Mr. Robert Hammond. See our "Official Notices," November 19th.

Dundee.—December 20th. The Gas Commissioners are inviting tenders for a supply of service fuse boxes for the electricity undertaking. Electrical engineer, Mr. W. H. Tittensor. See our "Official Notices."

France.—December 14th. Tenders are being invited by the French Posts and Telegraph Authorities in Paris, for the establishment of two pneumatic pipe lines between the Post Offices in the Rue Monge and in the Rue Saints-Peres. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—December 23rd. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply, in five lots, of 90 kilometres of paper-insulated electric cables. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Gloucester.—January 18th. The Electricity Committee want tenders for boilers, dynamos, overhead crane, switchboard, accumulators, mains, arc lamps, meters, &c., for electric lighting. Consulting engineer, Mr. Robert Hammond. See our "Official Notices."

Hammersmith.—December 22nd. The Vestry wants tenders for the supply and erection of 2 375-H.P. slow speed vertical engines, and 2 300-kw. fly-wheel alternators coupled direct to the engines. See our "Official Notices."

Italy.—December 30th. Tenders are being invited by the Municipal Authorities of Catanzara, for the construction of a tramway between the centre of the town and the railway station, to be operated either by electricity, steam or cable.

Leicester.—January 31st. The Leicester Corporation invites designs and tender for motor vehicles for the collection of house refuse. Specifications and particulars, with drawings, to be sent to the Chairman of the Sanitary Committee, to the office of Mr. E. Geo. Mawbey, C.E., borough engineer, Town Hall, Leicester.

Newport.—December 15th. The Corporation wanted tenders for electric lighting plant for temporary lighting at Wentwood Waterworks (350 16-C.P. lamps). See our "Official Notices" last week.

Singapore.—December 31st. The Municipal Commissioners are inviting tenders for the lighting of street lamps for a period of five years. Particulars from Mr. C. C. Lindsay, 167, St. Vincent Street, Glasgow, or the secretary to the Municipal Council.

Spain.—December 16th. The Municipal Authorities of Villarramiel (Palencia province) are inviting tenders until December 16th for the concession for the electric lighting of the town during a period of 20 years. Tenders to be sent to El Secretario del Ayuntamiento de Villarramiel (Palencia).

Spain.—December 21st. The municipal authorities of Reus (Tarragona Province) are inviting tenders for the concession for the electric lighting of the town. Tenders to be sent to El Secretario, del Ayuntamienti de Reus (Tarragona).

St. Pancras. — December 28th. The Vestry wants tenders for the supply and erection of "arc lamp posts and circuits complete," also feeding and distributing mains. Particulars from the chief clerk to the electricity department. See our "Official Notices" last week.

Worthing.—The Electric Light Committee want offers from persons willing to instal and maintain the electric light in the borough. See our "Official Notices" last week.

CLOSED.

Hull.—There were nine tenders submitted for the supply of tramway rails, fishplates, soleplates, tie-rods and bolts for the Works Committee. The lowest tender, that of the Société Anonyme des Acieries d'Angleur, was accepted, their prices being: for 40 foot rails, £6 1s. 6d. per ton, and for 60-foot rails, £6 7s. per ton; fishplates, 2s. 4d. per pair; soleplates, 1s. 4d. each; and tie-rods, £10 12s. 6d. per gross. Taking into consideration the length of the rails offered, and the saving in joints and bonding by using long rails as compared with short (the city engineer reports), the tender of the Société Anonyme is the lowest upon every item, with the exception of that for tie-rods, for which their price is 2s. 6d. per gross above the lowest tender. The tender of the Belgian firm is accepted, subject to inquiries proving satisfactory, and to conditions being arranged with them to the satisfaction of the city engineer. The approximate quantities required (based on rails 60 feet long) are as follows:—2,800 tons of rails; 3,276 pairs of fishplates; 3,276 soleplates; 137 gross fishplate bolts and nuts; 183 gross soleplate bolts and nuts; 440 gross holding down bolts and nuts and 112 gross tie-rods.

Italy.—The contract for the supply of the accumulators required for the central station at Florence has just been placed with the Pollak Accumulator Company, of Frankfort-am-Main, Germany.

FORTHCOMING EVENTS.

1897.

Friday, December 10th, 8 p.m.—The Institution of Junior Engineers, at Westminster Palace Hotel. Paper on "Main Engine Auxiliaries in the Mercantile Marine," by Mr. Basil H. Joy, Vice-Chairman.

Physical Society meeting at the rooms of the Chemical Society, Burlington House, 5 p.m. (1) An exhibition of an Apparatus for Self-acting Temperature Compensation of a Standard Cell. By Mr. Albert Campbell. (2) "On Lord Kelvin's Absolute Method of Graduating Thermometers." By Mr. Rose Innes. Council meeting at 4.15 p.m.

Saturday, December 11th, at 7 p.m.—North East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne. Paper on "Some Methods of Filtering and Heating Feed Water," by Mr. A. H. Burbidge. Synopsis:—Introduction—Advantages of a Feed-Water Filter and Heater—Types of Feed-Water Filters and Heaters—Economisers—Conclusion.

Monday, December 13th.—Yorkshire College Engineering Society. "The Daimler Motor and its Application to Auto-cars" (*illustrated*), by J. S. Chritchley (Daimler Motor Company, Limited).

Northern Society of Electrical Engineers, at 8 o'clock, at Palatine Hotel, Hunt's Bank, Manchester. Discussion on Mr. C. H. Wordingham's paper will be resumed. Paper to be read by Mr. A. B. Mountain on "The Management of Boilers and Steam Plant, including Details of Steam Pipes and Fittings."

Society of Arts. Third of a course of three Cantor lectures on "Gutta-Percha," by E. F. A. Obach. Synopsis:—*The Clean Material.*—Chemical composition, mechanical and electrical properties—Application for various technical purposes—Use of hardened gutta-percha for golf balls—Absorption of oxygen and behaviour towards ozone—Deterioration and preservation—Artificial substitutes for gutta-percha—Concluding remarks.

Wednesday, December 15th.—Society of Arts. "The Purification of Sewage by Bacteria," by Samuel Rideal, D.Sc.

The Institution of Electrical Engineers. Students' meeting at 7.30 p.m. Mr. J. M. Donaldson will read a paper, entitled "Notes on the Dover Tramways."

Chemical Society, Burlington House, at 8.30 p.m. Extra meeting. Kekute memorial lecture, Prof. F. R. Japp, LL.D., F.R.S.

Thursday, December 16th, at 8 p.m.—Chemical Society, Burlington House. Papers to be read: "Researches in the Stilbene Series, Part II." J. J. Sudborough, Ph.D. "Stereochemistry of Unsaturated Compounds, Part I.—Esterification of Substituted Acrylic Acids." J. J. Sudborough, Ph.D. and Lorenzo Lloyd. "Formation and Hydrolysis of Esters." J. J. Sudborough, Ph.D, and M. E. Feilmann, B.Sc.

Friday, December 17th, at 8 p.m.—Institution of Electrical Engineers. (By kind permission of the Chemical Society, at their rooms, Burlington House, W.) Ordinary general meeting. Continuation of discussion on Mr. Epstein's paper on "Accumulator Traction on Rails and Ordinary Roads."

The Institution of Civil Engineers, at 8 p.m. Students' meeting. Papers to be read:—"The Elastic Properties of Steel Wire." By Mr. Archer D. Keigwin, Stud Inst.C.E. "The Elasticity of Portland Cement." By Mr. W. L. Brown, B Sc., Stud.Inst C.E.

Tuesday, December 21st.—Brazilian Submarine Telegraph Company. Interim dividend payable.

Tuesday, December 28th.—The Royal Institution. The first of a series of six Christmas lectures (juvenile) on "The Principles of the Electric Telegraph," by Dr. Lodge, F.R.S.

NOTES.

The Chitty Dynamo.—As we go to press, we have received the following letter from Messrs. Willans and Robinson, Limited, of Rugby:—"Our attention has been called from several quarters to the prospectus of the Chitty Dynamo and Motor Company, Limited, which, marked 'for private circulation only,' has, we know, been widely distributed. In it are printed, on pages 8 and 9, two tables of tests carried out by us upon a small Chitty dynamo, and on page 13 a diagram of certain curves of efficiency. The other diagrams at pages 10, 11, and 12 were not compiled by us. The last paragraph of the prospectus, page 6, states that:—'Copies of the reports and tests by Messrs. Willans and Robinson are appended.' No copies of reports by us are appended. The paragraphs on page 7 are headed:—'The Chitty Dynamo: Messrs. Willans & Robinson's Tests,' and the first paragraph commences:—'Following are copies of the records of Messrs. Willans & Robinson's tests.' It appears to us that these words, coupled with the statement on page 6 that 'reports' by us are appended, may be taken to mean that the statements on page 7 are in the nature of a report from us. We shall be greatly obliged if you will allow us to state publicly in your columns that we are responsible only for the facts set forth in the tables on pages 8 and 9, and in the diagram on page 13 of the prospectus."

The Electro-Chemical Company's Plant.—As we go to press we have received the following letter:—"In the report of the proceedings at the annual general meeting of the shareholders of the Electro-Chemical Company, Limited, which appeared in your last issue, the chairman of the Directors, Col. Holland, C.B., is said to have stated 'that though the commencement of their business had been impeded

owing to the inefficiency of the first machinery supplied, they now had excellent engines and dynamos, and a good workable plant, giving the best possible results. The machinery of five installations, amounting to 3,500 E.H.P., were all fixed and in position on the premises, and arrangements had been made for a further 1,600 H.P.' As we built the whole of the dynamos that are now running so satisfactorily, and are building the additional machinery referred to, and as we had nothing whatever to do with the first electrical plant to which Col. Holland referred, we think it only fair to ourselves that we should make this explanation.—P. R. Jackson & Co., Limited; J. Slater Lewis, general manager."

Electric Organ.—The *Birmingham Post* is responsible for the statement that the electrical action is to be abolished and tubular-pneumatic substituted in connection with the organ at Holy Trinity Church, Stratford-on-Avon. It is stated that of late years the organ has been a constant source of trouble, mainly through the electrical apparatus getting out of order. They seem to have had some lively times with that organ. Imagine the Mayor and Corporation assembled in state, and the instrument positively refusing to sound a note! Then at other times going off "in a tantrum during the service, and give vent to the most horrible shrieks and groans during the prayers, driving the poor organist well nigh frantic." But these statements may be taken *cum grano salis*, for may they not be the offspring of the imaginative mind of the provincial reporter!

Royal Institution.—The following are among the lecture arrangements before Easter:—Prof. Oliver Lodge, six Christmas lectures (specially adapted for young people) on "The Principles of the Electric Telegraph;" Prof. Dewar, three lectures on "The Halogen Group of Elements;" Prof. J. A. Fleming, five lectures on "Recent Researches in Magnetism and Diamagnetism." Succeeding discourses will probably be given by Mr. A. A. Campbell Swinton, Dr. J. Hall Gladstone, Captain Abney, Prof. Dewar, and other gentlemen.

A general monthly meeting of the members was held on Monday, Sir James Crichton-Browne, treasurer and vice-president, presiding. The special thanks of the members were returned to Prof. Dewar for his present of a portrait of Mr. Benjamin Vincent, honorary librarian of the Royal Institution.

Mr. Baynes Interviewed.—A representative of the *Daily News* has interviewed Mr. Sydney W. Baynes, of the St. Pancras electricity works, on the subject of electric lighting and heating, and an article nearly two columns in length appears in yesterday's issue. Among other subjects, Mr. Baynes explains, for the benefit of the general public, why it is that day-load current can be supplied so much cheaper than the night load.

The Glasgow Appointment.—The Electricity Committee has made a proposal to the Council respecting the list of six candidates for the post of Corporation electrical engineer. It is suggested that a deputation of three be appointed to come to London and make further inquiries into the standing and ability of the six gentlemen. The following is a list of the six selected:—Messrs. Baynes (formerly of Bradford); Chamen, outdoor manager to Messrs. Crompton & Co.; Munro, of Anderson & Munro, Glasgow; Sharp, who laid down the electric lighting station at Kelvinside; Stewart, of Clydebank; and Wright, of Brighton, who requests £1,200 as salary.

King's College Engineering Society.—The fourth annual dinner of the above society was held on Friday, December 3rd, at the Holborn Restaurant, Dr. Robertson, D.D., the Principal of King's College, being in the chair. This year being the jubilee of the society, several old students were present.

Meter Patents.—We have received some correspondence from Messrs. Chamberlain & Hookham on the above subject, but as it refers to matters which are more or less *sub judice*, we refrain from publishing it at present.

New & Mayne, Limited.—In Tuesday's *London Gazette* a notice was published to the effect that meetings of the creditors and contributories of the above company will be held on Wednesday, December 15th, at the Westminster Palace Hotel, for the purpose of considering a scheme of arrangement. Copies of the scheme can be seen at the office of the solicitors to the liquidator, Messrs. Hind and Robinson, 8, Stone Buildings, Lincoln's Inn, W.C.

Personal.—A presentation on behalf of numerous members of the Engineering Department, and others of the Postal Telegraph service, was made yesterday afternoon to Mr. David Lumsden, late Submarine Superintendent, on his retirement after 44 years of service. The presentation was made by Mr. J. C. Lamb, assistant secretary, who referred in felicitous terms to the valuable services of Mr. Lumsden, and to the regret felt by everybody who had the pleasure of his acquaintance that his tenure of office had come to an end. Mr. Lumsden acknowledged the presentation, which consisted of a handsome silver tea service, in suitable terms. He is succeeded, we understand, by Mr. W. Culley.

Mr. Thomas Collins, for four years assistant superintendent of the Brighton Postal Telegraph Office, has now been made superintendent.

Mr. Frank B. Lea has taken an appointment as engineer with the British Electric Traction Company.

Wisdom has prevailed at the Worcester Council, and by a fair majority, that body on Monday increased the salary of the borough electrical engineer, Mr. Ruthven Murray, from £250 to £350 per annum. The absurd reasons given some weeks ago for postponing the matter have already been referred to in the REVIEW. Mr. Ruthven Murray has our congratulations.

Shock Fatality.—A Bangkok paper to hand records a fatal accident which occurred some weeks ago at a butcher's shop at Nishikicho, Kanka. A young servant girl grasped a house wire, off which the insulation had been worn.

Lectures.—Before the Scottish Industrial Art Association at Edinburgh, last week, Mr. A. W. Brown lectured on "Electricity as a Science."

At the Royal Technical Institute, Salford, on 30th ult. Principal Wilson lectured on "Electric Traction."

Marriage.—At the parish church, Howden, on 30th ult., Mr. Geo. A Neale, head of the electrical department of the Hull and Barnsley Railway Company, Howden, was married to Miss Maud Mary Walmsley.

Motor Car Patents.—A correspondent says:—"Mr. T. H. Parker (son of Mr. Thomas Parker, J.P., of Wolverhampton) has sold his motor car invention, and the five or six patents connected therewith, to a new company just registered under the title of 'The Electric Street Car Manufacturing Syndicate.' The capital of the company is £25,000, and it has been subscribed by Wolverhampton gentlemen."

Obituary.—All telegraph men will learn with regret of the death of Mr. Graves, the assistant superintendent of the Persian Gulf Telegraphs. It is stated that he was engaged inspecting the line between Jask and Chauber, at a distance of 90 miles from the former place, and was attacked in camp by tribesmen, who entered his tent at dusk, and, pinning him to his bed, disembowelled and decapitated him. The native staff escaped. The camp was looted and destroyed. Mr. Graves was 53 years of age, and was well known as one of the pioneers of the telegraph in Persia.

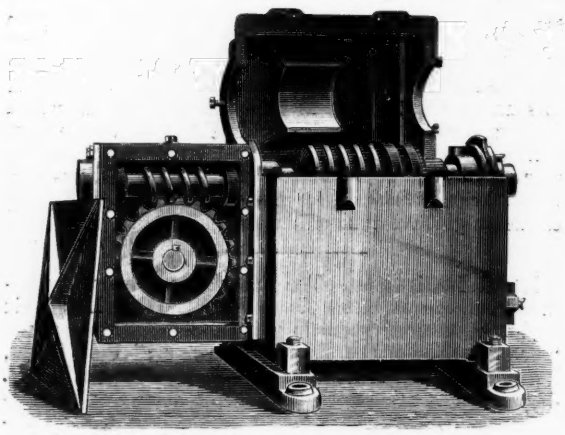
Donnison, Berlyn & Co. v. Beresford.—This case—a part report of which appears in another column—was settled yesterday, the jury returning a verdict in favour of the plaintiffs, the amount to be determined between the parties.

Edison's Latest Invention.—The American papers lately have been very full of a so-claimed invention of Edison's which is to play an enormous part in the future of the iron trade of the world. The usual gush is outpoured about the dogged determination of this man of courage and mental vigour, and millions of dollars are thrown about in a way that suggests they must be some other body's. One feels inclined to say with Ebenezer Twiddlepump, "My word, you do throw your money about!" In brief, the invention consists in pulverising magnetic ores and separating the magnetic particles by means of electro-magnets. Except that the work appears to have been carried out on a very large scale, and has taken a very long time to perfect, the whole thing strikes one as neither novel nor ingenious. Electrical separators are not new, and given ore to separate one can scarcely see how eight years can have been required to work out a system such as is described. The pulverised ore is dropped in a sheet which is subject to the deflecting influence of magnets. Part of the stream falls vertically on one side of a division plate, part falls slightly out of the vertical upon the other side of the division. The system is really that of a magnetic winnow. We read somewhere an account of certain breakages in the crushing rolls used by Edison on this low grade ore. Certain parts were always breaking, and no one could tell why, and the office boy being evidently on his holiday was not present to inform his directors that the blarmed thing was too weak. But Edison himself sat up all night once again. We say once again, because it was reported a few years ago that being full of business he did the same on the night of his wedding. He sat up all night and covered reams of paper with calculations, discovering thereby that when two, or was it three, particularly obdurate lumps of ore presented themselves in a certain manner to the crushing rolls, the mysterious breakage was bound to occur. When the late Mr. Menelaus, the ironmaster, was asked how to design rolls, he said, allow for every possible stress and the largest necessary factor of safety, and design your rolls. Having done so, and made everything superlatively strong, start afresh and make everything six times stronger. Either Edison is extremely funny, or his interviewers get hold of him the wrong way, to set down such a lot of rubbish about him. The Iliad itself does not contain such records of impossible feats. Probably the plain fact of the great new discovery is simply that the ore is there, and it appears capable of profitable use, and so it pays to use an old idea to effect its concentration. This low grade ore has not been there all this time without being known to American iron-workers. New Jersey's production of iron has seriously declined, falling from 745,000 tons in 1880 to only 282,000 tons in 1895, an amount considerably less than it was in 1870. Iron manufacturing has gone West, to a region of better grade ores and greater railroad enterprise, and it is doubtful if even the concentration of the low grades up to 90 per cent. concentrates, will replace New Jersey in its former position.

Canadian Electrical Affairs.—A Canadian correspondent of the *Financial News* states that active negotiations are proceeding between a group of capitalists at Toronto and a large number of electrical and gas lighting undertakings throughout the Dominion of Canada, but especially in the province of Ontario. The idea is to amalgamate all these different enterprises under one management, and thereby to effect considerable economies in the cost of administration. The syndicate is stated not to contemplate purchase outright in every case, but simply the acquisition of a sufficient control to direct the policy of the various concerns in accordance with the ideas of the central organisation. The correspondent states that an idea prevails that the whole enterprise will ultimately be offered to English investors, but he has been unable to obtain any definite confirmation of this.

Fatality.—On Monday, at the works of the Brush Electrical Engineering Company, Loughborough, a fitter, named William Bray, met with a fatal accident while armature turning. His head, which was caught by the clip which bound the armature on the face plate of the lathe, was cut in pieces, and, of course, death was instantaneous.

Enclosed Motor with Worm Gear.—The enclosed motor shown in our illustration has been made by the Phœnix Dynamo Company, Bradford, to operate the hoisting motion of a 30-ton Goliath crane, working in the open air at a bridge yard. As the full load of 30 tons has very seldom to be lifted, the slow speed of lift of 2 feet per minute was decided upon for the full load; lighter loads being, of course, lifted at proportionately quicker speeds. The rated power of the motor is 6 B.H.P. at 1,000 revolutions on a circuit of 230 volts, but it is capable of exceeding this power considerably for short periods. The machine is series-wound, with drum armature and carbon brushes; the electrical efficiency is 92·2 per cent. The worm gear is contained in a cast-iron case, bolted to the end of the motor, and forming the end bearing. The worm is of steel, turned and polished, and the worm wheel is of gun-metal, with the teeth cut to suit the worm. As the motor is reversible, ball thrust



bearings are fitted at each end of the worm, the ball races being correctly arranged to give rolling contact. Each ball bearing is self-contained, and can be removed from the shaft without losing the balls. The cover plate of the gear case has an oil-tight joint, and the lower part of the worm wheel runs in oil, which it carries up to the worm and bearings continuously. The travelling motion of the crane is operated by a similar motor, chain gear being used to obtain the reduction of speed. The Phœnix Dynamo Company are making a speciality of these enclosed type motors, and have at present in hand two of 100 B.H.P. each, two of 50 B.H.P. each, and a number of smaller ones ranging from 1 to 10 B.H.P.

The Royal Society.—Before yesterday's meeting the following papers were down for reading:—Lord Rayleigh, F.R.S., "On the Densities of Carbonic Oxide, Carbonic Anhydride, and Nitrous Oxide." S. S. Hough, "On the Application of Harmonic Analysis to the Dynamical Theory of the Tides." Part II. "On the General Integration of Laplace's Dynamical Equations." Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S., "A Note on Some Further Determinations of the Dielectric Constants of Organic Bodies and Electrolytes at Very Low Temperatures." J. R. Ashworth, "On Methods of Making Magnets Independent of Changes of Temperature, and Some Experiments upon Negative Temperature Coefficients in Magnets." V. H. Veley, F.R.S., and J. J. Manley, "The Electric Conductivity of Nitric Acid." Prof. J. V. Jones, F.R.S., "On the Calculation of the Coefficient of Mutual Induction of a Circle and a Coaxial Helix, and of the Electro-magnetic Force between a Helix and a Coaxial Circular Cylindrical Sheet." Prof. W. Ramsay, F.R.S., and M. W. Travers, "On the Refractivities of Air, Nitrogen, Argon, Hydrogen, and Helium."

E.P.S. Batteries.—A Royal Warrant has been granted to the Electrical Power Storage Company, Limited, appointing them makers of electrical secondary batteries to Her Majesty. We understand that this is the first Royal Warrant granted to any electrical firm, although electric lighting has been in use at several of the royal palaces since 1882.

Gorner Grat Electric Railway.—The first trial trips on the electric railway up the Gorner Grat, near Zermatt, were carried out some days ago in the presence of the inspectors of the Swiss Railway Department. The section already completed has a length of 1,600 metres and a gradient of 12 per cent. The tests gave complete satisfaction, both the ascent and descent of this gradient being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum gradient with a fully loaded train was also effected with great facility. It will be remembered that this is a rack railway, the total length being 9·8 kilometres and the maximum gradient 20 per cent. The power is derived from the Findelenbach, which drives four turbines of 250 H.P. each, coupled directly to three-phase alternators of 5,000 volts and 40 ~. Transformers are placed in the power house itself for feeding the line as it passes the building, and two other transformer stations are provided. The tension of the trolley line is 550 volts. Each locomotive is equipped with two three-phase motors of 90 H.P. each, driving the main pinions by spur gear. Owing to the property of three-phase motors, by which they will act as generators and take up the full power which they are designed to give out as motors, when driven at 2 or 3 per cent. above the speed of synchronism, the locomotive will, in descending, give power back to the line. In case only descending trains should be on the line, the surplus power will be taken up in a water resistance in the power house. The contractors for the whole of the electrical equipment are Messrs. Brown, Boveri and Co., who, in the well-known Lugano tramway, were the first to apply the three-phase system directly to traction. They have also supplied the electrical parts of the locomotive for the Jungfrau railway, where their system is to be adopted, and are now engaged on the equipment of the line from Stansstaad to Engelberg, which is to be running next spring. The standard gauge line from Burgdorf to Thun, in Canton Bern, is also to be equipped by them on the three-phase system, the power being taken from the power station on the Kander.

Copper.—If anything like a fair proportion of the 70 different electric lighting schemes, of which notice has already been given for application to Parliament should be passed by the Committee, the dulness which at present characterises the copper market ought to disappear, says the *Financial News*, deliveries be increased, and prices correspondingly augmented.

Electric Balloon Signalling.—In the Lecture Room of the Imperial Institute, recently, Mr. Eric S. Bruce delivered a lecture, fully illustrated by experiments and working models, on "Electric Balloon Signalling Applied to Scientific Exploration in Arctic and Antarctic Expeditions." Mr. Bruce referred to the difficulties of exploration, and the importance of having means of communication. He said that if a light could be placed some hundred feet above the vessel, by means of flashing signals communication could be maintained between the vessel and those who had left her. An 18-inch goldbeater's skin balloon, filled with coal gas, would lift itself. The lights he used were placed in ladder form, and were incandescent, and the cable was very flexible, being of stranded copper. For Arctic work, he would recommend a balloon of 7 feet, which would lift 500 feet of cable, with a cubic capacity of 150 feet. To fill that, the explorer would have to take out a steel tube of compressed hydrogen about 8 feet long. He placed his lamps inside the balloon, although he lost illuminating power, because experience had shown that was best. When incandescent lamps were flashed the filament remained red hot for a moment, and in the open that would be visible and connect the flashes, whereas in the balloon the after-glow was not seen. There was no danger in the lamps being inside a balloon filled with coal gas or hydrogen, as the lecturer showed by experiments with a glowing wire and by the electric spark inside a globe full of coal gas. With guy ropes a balloon could nearly always ascend, and as to the mirage sometimes seen in Arctic regions, the varying shapes of the mirage would soon show the explorer that the vision was not a reality. He believed that electric balloon signalling would be of great use in Arctic exploration.

A Suggestion for the Exhibition of 1900.—If it is not too late to offer suggestions for the Universal Exhibition of 1900, "E. H.," in *L'Industrie Electrique*, proposes one which would be very easy of realisation, and which would impart to this great international manifestation the character of a review of the century, which is its principal *raison d'être*. If this review is to be profitable and instructive, we must impart to it the unity of subject, the unity of time, and the unity of place, now wanting in its arrangement. In fact, in consequence of the dispersion of the buildings, the enormous extent of the exhibition, the division into nations, and the strictly individual—not to say personal—character that will distinguish the installation of each stand, unity of subject and unity of place will be entirely absent. Unity of time will also be wanting, for the historical, scientific, and practical demonstrations of each industry—to speak of industry alone—will probably be spread over the whole half-year, and to follow them all, it would be necessary to spend six months in Paris, which will be impossible for the greater number of visitors. The proposal brought forward by "E. H." would have the effect of suppressing almost all these objections, and would give each of the great branches of human activity represented at the exhibition the connectedness required in order for us to be able to follow easily, methodically, and quickly its evolution during the 19th century. These are the principal points of the writer's idea:—Without in any way altering what has already been done, or what is being done, it would be sufficient to arrange what we will call *weeks* of the exhibition, we will say about 20, for the sake of clearness, each being devoted to a special subject of which it will bear the name. Thus there would be, say, a week of lighting, a week of photography, a week of the transport of energy, a week of means of transport, a week of printing, a week of weaving, a week of motive power, a week of agricultural machinery, &c. Moreover, several simultaneous parallel series might be formed, in absolutely different branches, so as to prevent visitors getting tired of one subject and to avoid confusion. In the week devoted to a certain subject, the special congress for that subject would, of course, be held, historical technical entertainments would be given by specialists, and on Sunday, to conclude the week, a grand popular conference would be held. Concurrently with this course of instruction, we should like to see one room set aside for a retrospective exhibition organised each week, in which would figure, systematically classified, the principal typical apparatus, represented either by drawings or models, showing the progressive stages of development of the subject under consideration. The organisation of each week would be entrusted to an independent and competent person who would draw up from the exhibits placed at his disposal a catalogue, which should be brief but at the same time sufficiently extensive to give visitors a concise but exact notion of the progress of the week. As each special exhibition would terminate on Sunday evening, the exhibits might be removed on the Monday, and the next ones installed on the Tuesday and Wednesday. By opening on Thursday morning, there would be four full days of the special exhibition, which would be quite sufficient, as each of these weeks devoted to a special subject would only appeal to that portion of the public directly interested. We (E. H.) might say a great deal more about this idea, of which we have only given here the first principles; unfortunately, as it does not possess a sensational feature, there does not seem to be any great chance of its being adopted; we will not, therefore, try the patience of our readers by developing it any further.

Personal.—Mr. W. H. Preece, C.B., F.R.S., the engineer-in-chief of the General Post Office, who has been on the sick list for several weeks past, has left in the P. and O. ss. *Britannia* for the Mediterranean.

NEW COMPANIES REGISTERED.

Brind, Gillingham & Co., Limited (54,977).—Registered November 26th, with capital £8,000, in £5 shares, to acquire the business carried on at Abingdon, Berks, as "Coxeter and

Sons," and to carry on the business of ironmongers, electrical engineers, and dealers and workers in all electrical apparatus and fittings. The subscribers (with one share each) are:—J. Coxeter, 54. Oak Street, Abingdon, ironmonger; R. W. Brind, 20. Victoria Road, Abingdon, traveller; W. P. Gillingham, 48, Oak Street, Abington, clerk; W. Flag, Victoria Road, Abingdon, ironmonger; A. W. Hodgson, 4, Spring Gardens, Abingdon, ironmonger; C A. Pryce, 34, East Street, Helen Street, Abingdon, solicitor; A. E. Preston, 55, Corn Market Street, Abingdon, chartered accountant. Table "A" mainly applies. Registered by A. Doubble & Co., Mitre Court, Fleet Street, E.C.

Electric Street Car Manufacturing Syndicate, Limited (55,099).—Registered December 3rd, with capital £25 000 in £1 shares, to adopt agreements (1) with T. H. Parker and T. Parker; (2) with the London Electric Omnibus Company, Limited; and (3) with T. H. Parker, and to carry on the business of manufacturers of and dealers in motor cars, carriages, vans, cycles, and other vehicles, electrical and general engineers, boiler makers, machinists, &c. The subscribers (with one share each) are:—T. Parker, J.P., M.I.C.E., Tettenhall, Wolverhampton; T. H. Parker, Tettenhall, Wolverhampton, electrical engineer; T. Wardley, High Street, Wolverhampton, fish dealer; S. Craddock, J.P., Park Road East, Wolverhampton, manufacturer; M. Fletcher, 32, St. James Square, Wolverhampton, clerk; W. E. Crook, Tettenhall, Wolverhampton, engineer; A. E. Parker, Tettenhall, Wolverhampton, electrical engineer. The number of directors is not to be less than three nor more than five. The first are S. Craddock, T Parker, E. Lisle, S. Flood Page, and T. H. Parker; qualification, £500; remuneration as the company may decide. Registered by Maude & Tunnicliffe, Arundel House, Arundel Street, W.C.

Cardiff and Penarth District Light Railway Company, Limited (55'101).—Registered November 30th with capital £25,000, in £1 shares, to apply for power to construct a light railway from Penarth to Cardiff; to construct, lay down, maintain, manage, and work any railways, slight railways, tramways, omnibuses, steamers, tolls, ferries, &c., and to supply electric and other light and power. The subscribers (with one share each) are:—V. B. Cooper, Broadway House, Westminster, engineer; S. P. W. Sellon, Donington House, Norfolk Street, W.C., engineer; C. S. Peach, Victoria Mansions, Westminster, architect; J. G. Billiot, 18, Eldon Street, E.C., secretary; C. J. March, 3, Church Street, Old Jewry, E.C., chartered accountant; E. Schenk, 69, Curzon Street, Mayfair, gentleman; H. Heywood, Withe Court, near Cardiff, gentleman. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification, £250; remuneration, £150 per annum, and £250 for the chairman. Registered by Vachell & Co., Cardiff.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South American Cable Company, Limited (34,363).—This company's annual return was filed on November 19th, when 24,707 shares were taken up out of a capital of £500,000 in £10 shares; 10,000 are considered as paid, and £147,070 has been paid on the rest.

Vaughan & Brown, Limited (43,247).—This company's annual return was filed on November 18th. The capital is £40,000 in £5 shares (4,000 preference); 2 690 ordinary and 3,349 preference have been taken up, and 4,000 are considered as paid; £5 per share has been called on the others, and £10,195 has been paid.

Walter V. Scott & Co., Limited (52,120).—(Electric Generator Manufacturers) —The registered office of this company is now situate at 118a, Cromwell Road, London, S.W.

Ryde Electric Light and Power Company, Limited (53,086).—This company's statutory return was filed on November 11th, when seven shares were taken up out of a capital of £10,000, in £1 shares. No calls have been made. The registered office has been removed to Broad Sanctuary Chambers, Westminster, S.W.

Weymouth Electric Light and Power Company, Limited (53,120).—This company's statutory return was filed on November 11th, when seven shares were taken up out of a capital of £10,000 in £5 shares. No calls have been made. The registered office has been removed to Broad Sanctuary Chambers, Westminster, S.W.

Sax, Slatter & Co., Limited (53.362).—This company's annual return was filed on November 24th, when 5 500 shares were taken up out of a capital of £10,000, in £1 shares; 500 are considered as paid, and £5,000 has been paid on the rest.

CITY NOTES.

Rand Central Electric Works.

The directors have issued the report for the period ended June 30th. They state that the contractors were, through unforeseen and unavoidable circumstances, prevented from completing the works at the specified time, viz., November 20th, 1896. However, notice of completion was given by them on July 1st last, and the general manager has given his certificate that the installation is erected in a first-rate and liberal manner. The guarantees and specification described in the equipment contract have been amply fulfilled, and the various tests made of the engines and plant at Brakpan have given satisfactory results, the engines exceeding their guaranteed efficiency of together 2,100 H.P. by about 10 per cent. With regard to the claim the company would have been entitled to, owing to the delay in completing the works, the directors, after careful consideration of all the facts, came to the conclusion that the interests of the shareholders would be best served by arriving at a compromise with Messrs. Siemens & Halske. An agreement was consequently concluded by which, in lieu of penalties, the period of that firm's dividend-guarantee commences as from January 1st, 1897. As regards the company's contracts for power supply, which a year ago aggregated about 1,200 H.P., it may be stated that the company now has concluded agreements for supplying power to the extent of the full capacity of the works. In order to ensure an uninterrupted working, the directors have completed negotiations for obtaining a supply of water from the President's dam, to be used as a reserve, and sufficient to meet future requirements. Up to June 30th last, 85 per cent. of the amount of the equipment price had been paid to the contractors, and the balance is now in course of settlement. Other payments have been made on account of mine installations, which remain the property of the company, the total expenditure being estimated to amount to about £30 0 0. These installations are for various purposes, viz., pumping, hauling, driving, lighting, &c., and, as the different modes of adapting the company's power require various types of transformers and motors, which have had to be ordered in Europe, several months must elapse before all the connections can be ready.

The general meeting of this company will be held at Winchester House, E.C., on the 14th inst. The transfer books will be closed from the 7th to the 14th inst., inclusive.

Prospectus.—In another part of this issue will be found the prospectus of the Smithfield Markets Electric Supply Company, Limited (capital £100,000). 12,000 £5 ordinary shares and £50,000 4 per cent. debenture stock at £105 per £100. As the name of the company implies, the object is to light the Smithfield markets by electricity. Mr. V. B. D. Cooper is the consulting engineer. An important feature of this undertaking is the specially arranged terms of supply. These have been drawn up with the express object of inducing all shopkeepers and others in the market to go in for electric lighting on a large scale. The terms are specially favourable for large consumers on a rebate system; but so far as we know, they differ from those in vogue in any other part of the country. The rates are 4d., 5d. and 6d. per unit respectively, according to the number of units consumed "per square foot of floor space per quarter." When the company supplies 600,000 units per annum to the market, it will reduce the rates by ¼d. per unit for every additional 100,000 units up to a million. All incandescent lamps will be replaced free of charge, and fittings will be either sold outright, or let on hire.

Eastern Extension Telegraph Company.—The directors have declared an interim dividend for the quarter ended September 30th last of 2s. 6d. per share, free of income-tax, payable on January 15th. The coupon of the company's 5 per cent. Australian Government subsidy debentures, due on January 1st, will be paid on and after that date at Messrs. Barclay & Co.'s Bank, 54, Lombard Street, E.C., coupons to be left three clear days for examination.

Coventry Electric Tramways Company.—The directors have declared a dividend for the half-year ended 3rd inst. of 8 per cent. per annum, being the same rate as that paid in the preceding half-year. The contracts have been let for the works requisite in the electric tramways extensions, and stipulations are provided that the whole of such works shall be carried out before October 1st, 1898.

Commercial Cable Company.—The directors have declared a quarterly dividend of 1¾ per cent. on the capital stock, and a bonus of 1 per cent., payable on January 1st next.

Gutta-Percha Corporation.—The first batch of letters of allotment has been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 5th, 1897, were £1,097; week ending December 6th, 1896, £1,052; increase, £45; total receipts for half-year, 1897, £21,880; corresponding period, 1896, £21,947; decrease, £67.

The Great Northern Telegraph Company. The receipts in November, 1897, were £24,800; January 1st to November 30th, 1897, £252,800; corresponding months, 1896, £261,600; corresponding months, 1895, £286,400.

The Liverpool Overhead Railway Company. The receipts for the week ending December 5th, 1897, amounted to £1,286; corresponding week last year, £1,069; increase, £217.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 3rd, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,002.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	Name.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Dec. 1st.	Closing Quotation, Dec. 8th.	Business done during week ended December 8th, 1897. Highest.	Lowest.
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	101 —105	101 105	104	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5½ — 6½	5½ — 6½	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	58 — 60	58 — 60	59¼	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	104 — 105	1 4½ 105½	105¼	104½
3,038,020£	Do. do. Defd.	Stock	...	...	...	12¼ — 12¾	12¼ — 12¾	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	16 — 16½	16 — 16½	16 7/16	16¼
75,000£	Do. do. 5 %, Debs., 2nd series, 1905	100	5 %	5 %	...	114 —118	114 — 118	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	183 —188	183 —188	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106⅜	105¾
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	7/16 — 9/16	7/16 — 9/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	8½ — 9½	8½ — 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ — 19½	18½ — 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	4½	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	4½%	103 —106%	103 —106 %	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	10 — 10½	10 — 10½	10 7/16	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	17 — 17½	17 — 17½	17½	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	18 — 19	18 — 19	18½	18¼
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 —104	101 — 104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	131 —134	130 —133	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7¾	18¼ - 18⅝	18¼ - 18⅝	18⅝	18½
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	}100	5 %	5 %	5%	100 —104	100 —104	...	...
100,500£	Do. do. Bearer, 1,050—3,975 and 4,327—5,400	100	5 %	5 %	5%	101 —104	101 —104	103	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	131 —134	131 —134	133¾	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	}100	5 %	5 %	5%	100 —104	100 - 104	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	}100	4 %	4 %	4%	103 —106	103 —106	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	108 —111%	108 —111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½ — 12	11¼ — 12	11 13/16	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17½ — 18	17½ - 18	17⅝	17½
150,000	Great Northern Teleg. Company of Copenhagen ...	10	8⅝%	10 %	10%	26 — 27	25½ — 26½	25⅞	25⅝
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	102 —105	102 —105	102½	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	52 — 55	52 — 55	52½	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	107 —1.0	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6½ - 6¾	6⅝ - 6⅝	6½	6 1/16
15,000	Do. 6 % Cum. 1st Pref.	100	6 %	6 %	6 %	15 — 17	15 — 17	15½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	10	6 %	6 %	6 %	14 — 16	14 — 16	...	...
130,766	Do. do. Nos. 119,235 to 250,000, £4 paid	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6¼	6¼
1,329,471£	Do. 3½ % Deb. Stock Red.	} 5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	Stock	3½%	3½%	3½%	104 —109	104 —109	105½	105¼
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	1	4½%	5 %	5 %	9/16 — 11/16	9/16 — 11/16	...	...
11,839	Reuter's Ltd.	}100	4 %	4 %	4 %	107 —110	107 —110	...	...
3,381	Submarine Cables Trust	8	nil	5 %	5 %	7 — 8	7½ - 8½	...	...
58,000	United River Plate Teleph., Ltd.	Cert.	...	...	...	136 —141	136 —141	138¼	...
146,733£	Do. do. 5 % Debs.	5	3 %	4 %	...	3¾ - 4¼	3⅝ — 4¼	4⅛	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	Stock	5 %	5 %	...	102 —107	102 —107	...	...
213,400£	Do. do. do. 5 % Debs.	10	nil	4 %	nil	4½ - 5½	4½ — 5½	...	...
64,256	Western and Brazilian Teleg., Ltd.	100	5 %	5 %	5 %	103 —106	103 — 106	...	...
33,129	Do. do. do. 5 % Pref. Ord. ...	15	3 %	3 %	2 %	9½ - 10 xd	9½ - 10 xd	9 13/16	...
33,129	Do. do. do. Def. Ord.	7½	5 %	5 %	5 %	7¼ — 7¾xd	7¼ — 7¾xd	7⅞	7¼
382,230	Do. do. do. 4 % Deb. Stock Red. ...	7½	1 %	1 %	...	2½ — 3	2½ — 3	2¾	...
88,321	West India and Panama Teleg., Ltd.	Stock	...	...	...	106 —109	106 —109	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	⅛%	⅛%	1 %	⅜ - ⅝	⅛ - ⅜	⅜	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8¼ — 8¾	7¾ — 8¼	8¼	7 13/16
80,000£	Do. do. do. 5 % Debs. No. 1 to 1,600 ...	100	5 %	5 %	6 %	5 — 7	5 — 7	5½	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7%	103 —107	107 —110	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6%	100 —105	103 —107	...	...
							100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12 — 13	12½ — 13½	13¼	12⅞
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6 7/16	6⅛
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	10½ — 11	10¼ — 11	10 15/16	10⅜
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	4½%	113 —116	113 —116	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	26½ — 27½	26 — 27½	27¼	26⅝
10,000	Do. do. Prov. Certs.	5	...	...	...	26 — 27	26 — 27	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17 13/16	17⅜
400,000	Do. do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —136	131 —136	134¼	133¼
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1— 30,000	10	...	nil	nil	14½ - 15	14⅜ — 15¼	15½	14 11/16
20,000	Do. do. do. 6% Pref., 40,001—60,000 ...	10	...	6 %	6 %	15½ — 15⅝	15½ — 16	15 15/16	15 15/16
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	9¼ — 9⅜	9¼ — 9⅜	9⅜	9⅜
10,000	Do. do. 7 % Cum. Pref. ...	5	...	...	...	11 — 11½	11 — 11½	11⅜	11 1/16
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	5 %	18⅜ — 19½	19 — 20	19 11/16	19⅜
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	18 — 19	18⅜ — 19½	19	...
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 — 123	119 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	16½ — 17½	17½ — 18½	18½	18½
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	16½ — 17½	16½ — 17½	17⅛	17
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	10½	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2¾ — 3	2¾ — 3	2 15/16	2⅞
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	5 %	7 %	9 %	15 — 16	16 — 17	16⅝	15½

† Quotations on Liverpool Stock Exchange.

* Subject to Founder's Shares.

‡ Unless otherwise stated all shares are fully paid.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Dec. 1st.	Closing Quotation Dec. 8th.	Business done during week ended Dec. 8th, 1897. Highest	Lowest
30,000	British Electric Traction	10	...	...	...	12⅜ — 13¼	15 — 15½	15⅞	13 1/16
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	5	2½%	...	...	1⅝ — 2	1⅝ — 2	1 15/16	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	2⅛ — 2⅜	2⅛ — 2⅜	2 1/16	2 1/16
125,000£	Do. do. 4½ % Perp. Deb. Stock... ...	Stock	4½%	...	...	107 —111	107 - 111	110	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	98 —102	98 —102	101	100½
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10½	9½ — 10	10	9⅜
143 10s	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5½ — 6	...	...
58,830	Do. do. Pref half-shares £1 pd. ...	...	...	...	...	1 — 1½	1 — 1½	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅝	4¼ — 4⅝	...	...
630,000£	City and South London Railway	Stock	1⅛%	1 1/16%	1 9/16%	68 — 70	66 — 68	67⅝	65
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅝ — 2¼	2 — 2½	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5 %	5½%	2½ — 3	2½ — 3	3	2⅞
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	5½%	4 — 5	4½ — 5½	5¼	4 13/16
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	6 %	2⅜ — 2⅝	2¼ — 2½	2 7/16	2 5/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3½ — 3⅝	3½ — 3⅝	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	½ — ⅝	½ — ¾	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½ — ⅝	½ — ⅝	11/16	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	..	...
12,500	Hanley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	20 — 21	20 — 21	20⅞	20¼
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	110 —115	110 115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	23 — 24	22½ — 23½	23⅜	22⅜
300,000	Do. do. do. 4 % 1st Mort. Debs	100	...	...	...	103 —107	103 —107	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅞%	2⅞%	11½ — 11⅝	11 7/16 — 11 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16 — 16½	16 — 16½	...	...
27,250	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	36 — 39	37⅜	36⅜
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	2 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000	10	...	...	...	12½ — 13	12½ — 13	12⅜	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1893—0%; 1894—7 3/4%; 1895—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.

Electric Construction Corporation, 6 % Debentures. 103—106.

House-to-House Company, 4½% Debentures of £100, 107—110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 14½—15½; 1st Preference Cumulative 6 %. £5 (fully paid), 8—8½. Dividend, 1896, on Ordinary Shares 7 %.

* From Birmingham Share List.

London Electric Supply Corporation, £5 Ordinary, 2¼—2⅜.

* T. Parker, Ltd., £10 (fully paid), 12¼.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount 3 per cent. (October 14th, 1897).

LIGHTHOUSES AND LIGHT-VESSELS.

(*Concluded from page* 786.)

Passing from the topic of light-vessels, we are pleased to note that the recommendation contained in the First Report (in the case of Caldy Island and Lundy Island on the West Coast of England, and the Tuskar and the Fastnet Rocks on the South Coast of Ireland) have been carried out, in addition to which we observe that the Maplin and Gunfleet, on the East Coast of England, and the Smalls on the West Coast, have been brought into communication. The work of the Smalls has not, however, been fully completed, and communication can only be as yet maintained at low water, which practically amounts to its being of little use during the winter and at a time when most needed.

Communication with the Fastnet Rock lighthouse was, according to the Final Report, established in July, 1895, but wholly failed in March, 1896, owing to the severance of the conductor at the juncture of the sea cable with the copper mushroom, and communication was not restored until June of this year, an interruption of 14 months. No doubt the failure in maintaining communication would be due to the heavy seas which run on the Fastnet, causing the light mushroom anchor, submerged in 11 fathoms at a distance of about 60 fathoms from the rock, to be twisted about, and break away from the conductor in connection with the main cable.

With regard to the Tuskar lighthouse, it is satisfactory to note that the telephonic communication established with this important isolated station has not been interrupted since it was effected in September, 1894.

The further list of outlying and shore lighthouses recommended to be placed in telephonic communication with the general telegraphic system of the country, will tend to the general improvement of our coast communication. A chart of the British Islands, similar to that showing the life saving stations in the Kingdom of Denmark, as an appendix to the Fourth Report of the Commission, would have been a useful addition to the Parliamentary Paper now before us.

The extension of storm warning signals to be displayed at lighthouses is highly commendable, and the annual cost of telegrams sent from the meteorological office to these stations, with the advantages that may be expected to result, are likely to be much more than commensurate with the expense involved.

We are heartily in accord with the hope expressed in the opening part of the Commission's concluding remarks in the Final Report, that the work of establishing electrical communication with lighthouses and light-vessels in the United Kingdom will not be allowed to drop now that the mission of its distinguished members has come to an end, and we further trust that the Departments of State interested in the matter will carry on steadily in the future the work that has been so successfully initiated during the past five years, it being taken for granted that provision for this will not be denied them. Care should be taken that in dealing with the question of cost, and in limiting it to what may be deemed a reasonable amount, the efficiency of the service may not be restricted.

The Departments of State referred to in the Report, upon whose co-operation the working of the system depends to a very large extent, include the Board of Trade, the Post Office, the Trinity House and other lighthouse authorities, the Royal National Lifeboat Institution, and the Admiralty, who direct the important services of the Coastguard.

From each and all of these Departments, the Commissioners say, they have received the most valuable assistance in the course of their inquiry.

In bringing our remarks to a close, we join with the

Commissioners in trusting that in future some arrangement may be adopted, and the co-operation of these Departments be continued in the carrying out of improvements as occasion may require without delay.

Quoting from the Final Report, the list of outlying and shore lighthouses connected with the general telegraph system of the country is now as follows:—

Outlying Lighthouses.

East Coast of England.
Maplin.
Gunfleet.

West Coast of England.
Smalls.
Caldy Island.
Lundy Island.

South Coast of Ireland.
Fastnet.

East Coast of Ireland.
Tuskar.

Shore Lighthouses.

South Coast of England.
Falmouth Harbour.
Start Point.
Anvil Point.
Needles.

East Coast of England.
Orfordness.
Souter Point.

East Coast of Scotland.
Montrose (Scurdy Ness).
Girdleness.
Covesea Skerries.
Tarbet Ness.
Noss Head.

Orkney and Shetland Islands.
Look-out Station at Brough Ness for Pentland Skerries lighthouses.
Cantick.
Fair Isle (North End).
Sumburgh Head.

West Coast of Scotland.
Cape Wrath.
Ru Stoer.
Rhynns of Islay (Oversay Island).
Mull of Cantyre.

West Coast of Scotland—*continued.*
Turnberry.
Corsewall.
Mull of Galloway.

Isle of Man.
Langness.
Douglas Head.
Point of Ayre.

West Coast of England, and Wales.
St. Bees.
Bidston.
Menai.
South Stack.
Llanddwyn.
Nash (both lighthouses).
Bull Point.
Hartland Point.

South Coast of Ireland.
Galley Head.
Minehead (Dungarvan).
Hook Point (Waterford).

East Coast of Ireland.
Dudley (Howth).

West Coast of Ireland.
Loop Head.
Kilcradan Point.

Working during 1896.

From the statement given in an appendix to the Report, it is seen that communication with the *Kentish Knock* light-vessel was interrupted on four occasions during the past year. One of these interruptions—that which occurred on February 22nd—was due to the parting of one of the vessel's mooring chains, which caused her to ride to the veering (electric) cable and break it, and it is probable that the interruption on January 9th was also caused by the vessel having ridden to the veering cable.

Two of the four interruptions do not appear, therefore, to be attributable to any defect in the system or apparatus used for establishing electrical communication.

The two remaining interruptions—those which occurred on January 3rd and September 23rd—were caused by the parting of the veering cable owing to its having been threshed on the bottom.

Only one accidental interruption in communication with the *Goodwin* (North Sand Head) lightship was caused during the year 1896, but the cable was removed from the vessel for two months and a half while the induction experiments already referred to were being carried on. The interruption was caused by the parting of the cable owing to its having been threshed on the bottom. Two interruptions in communication with the *Hasborough* lightship occurred during the year. On January 16th the veering cable parted at a kink which had been formed, and showed traces of having been nipped by one of the mooring chains; while on September 23rd it broke, as did also the cable to the *Kentish Knock* light-vessel, in consequence of the threshing on the ground to which it had been subjected by the heavy weather. Only one interruption in electrical communication with the *Shipwash* lightship occurred during 1896. This was caused by the rupture of the veering cable owing to its having been threshed on the bottom. There were four interruptions in communication with the *Formby* lightship during the year. One of these—that which occurred on September 17th—was due to no defect in the system employed, but was caused by the veering cable and a portion of the main cable having been carried away, presumably by a passing vessel. The interruption which took place on February 27th was apparently due to the vessel's mooring chains having twisted round the veering cable and broken it, while those which occurred on April 13th and 26th were caused by friction with the swivel to which the vessel's mooring chains are attached and through which the veering cable passes.

No difficulties have arisen in regard to the cables to the Gunfleet and Maplin pile lighthouses, or in regard to the cable to the Caddy island lighthouse during the year 1896, and no interruption in communication with these stations has occurred since the cables were first laid. One interruption, caused by the cable being chafed on a rough patch a short distance from the rock, occurred in the electrical communication with the Tuskar rock lighthouse during the year.

Considerable difficulty has been experienced in establishing and maintaining communication with the Fastnet and Smalls rock lighthouses. Communication with the Fastnet was effected in July, 1895, by a non-continuous system, which was explained in the Fourth Report, and, with a short interval, was maintained until the end of March, 1896, when one of the copper mushrooms parted from its cable. The heavy seas which run on the rock make it impossible for any work to be done except in quite calm weather, and it was not found possible to carry out the necessary operations until June last, when communication was restored, and will, it is trusted, now be satisfactorily maintained. The cable to the Smalls rock lighthouse was laid on October 1st, 1896. The weather, however, made it impossible for the cable to be properly secured on the rock, and although communication with the mainland has been obtained at low water, some work will have to be done before reliable communication can be established.

The record of interruptions in the telephonic communication with the *Goodwin*, *Hasborough*, and *Shipwash* light-vessels during 1896 is regarded as satisfactory; there being an average of little more than one interruption in the 12 months for each vessel, as against an average of two interruptions for each vessel during the year 1895. In the case of the *Kentish Knock* and *Formby* light-vessels, the record is not so satisfactory. Two of the interruptions in communication with the former and one in that with the latter vessel appear, however, to be due to accidents for which the system of connection cannot be held in fault, and if these interruptions are omitted from consideration, the record of the working of the cables to the connected lightships during 1896 does not compare unfavourably with that for 1895, which in turn showed a marked improvement over the record for 1894. In 1894 there was, on an average, an interruption every four months and a half, and in 1895 and 1896 about every seven months, accidents arising from outside causes being left out of consideration in each case. The *Kentish Knock* light-vessel lies 18 miles off the nearest point of the mainland, and is subject to heavier seas than those experienced at any of the four other lightships which are connected. There is, therefore, reason to believe that interruptions in communication with that vessel will continue to be more frequent than in the case of the other vessels. The conditions at the *Formby* light-vessel are not so unfavourable, and it is anticipated that with increase of experience on the part of the crew and with the alterations in the apparatus which have been suggested, interruptions in communication will tend to become less frequent. Of the twelve interruptions which occurred during the year 1896 in electrical communication with the five connected light-vessels, five appear to have been due to the threshing of the veering cables on the ground, a difficulty against which, as already stated, the Commissioners have found most trouble in providing. Three appear to have been due to causes outside the apparatus and system used; two were caused by friction with the swivel, and two by contact with the vessel's mooring chains.

The record of the working of the cables to the Gunfleet, Maplin, Caldy, and Tuskar lighthouses is very satisfactory.

Use made of the Connections.

In Appendices B. and C. to the report returns are given by the lighthouse authorities and by the Royal National Lifeboat Institution, showing cases in which use, for the purpose of giving information regarding vessels in distress and casualties at sea, has been made during the years 1895 and 1896 of the electrical communication established with lighthouses and light-vessels.

On most, and probably on all, the occasions on which vessels in distress were seen from the connected light stations visual or sound signals were also employed, and the Commissioners have no means of judging accurately how far those signals and how far the electrical communication were instrumental in sending assistance to the endangered vessels, but, as stated in the Third Report, they are satisfied that the telephonic connections which have been established with lighthouses and light-vessels have added in a very important degree to the effectiveness of the machinery which exists on our coasts for the purpose of rendering aid to vessels in distress, and of saving their crews from the perils of the sea.

By the terms of their appointment, the question which the Commissioners have had to consider when deciding whether they should recommend the connection of a lighthouse or light-vessel has been whether the expense of establishing the electrical communication is likely to bear a reasonable proportion to the value of the connection for the purpose of saving lives and property, either directly by enabling the services of lifeboats, the rocket apparatus, tugs, &c., to be rendered more speedily and certainly, or indirectly by affording at various parts of the coast warnings of the expected approach of storms. The value of electrical communication with light stations for general and commercial purposes is a question which, being outside the scope of their inquiry, the Commissioners have not investigated, and upon which they do not desire to offer an opinion, but would point out that, if at any future time it should be decided to utilise the connections for such purposes, some revenue would be obtained to meet, if only to a small extent, the heavy expenses of establishing and maintaining the wires and cables. They have already explained in the Fourth Report that the electrical communication which has been established by the Danish Government with their lighthouses is used for all the general purposes for which the postal telegraph wires are employed, and they understand that the same is, generally speaking, the case in other foreign countries, and in British Colonies, in which a system of electrical communication with lighthouses exists.

Recommendations.

(1.) *Light-vessels.*

Having regard to the present expense of establishing and maintaining electrical communication with light-vessels, the Commissioners do not feel justified in recommending the connection of any more of those stations until the ethereal system at present under trial

has been fully tested. In the event, however, of any improved system rendering the maintenance of communication with light-vessels less costly than it now is, they are of opinion that the *East Goodwin, Cross Sand, Kish, Tongue,* and *Sunk* lightships have the first claims to consideration, together with the *Scarweather* lightship, which has already been recommended.

The Commissioners expressed in their First Report the opinion that the *East Goodwin* was a most important station, but they refrained from recommending its immediate connection, on the ground that the maintenance of a cable would be difficult owing to the depth of water in which the vessel rides, and that a larger vessel than the present one would be required to carry the necessary moorings. They hold the same view in regard to the *Cross Sand* lightship, which is moored about six miles off the coast of Norfolk, where the conditions are also unfavourable. The dangerous nature of the shoals in the neighbourhood of these two light-vessels is shown by the number of casualties which have occurred on them during recent years, and they hope that the question of their connection will receive attention if any successful system applicable to such vessels is discovered.

The *Kish* lightship lies in 13 fathoms of water, about eight miles east of Kingstown Harbour. It commands a view over Burford Bank and Kish Bank, and there is a large passing trade, including the Irish packets running between Holyhead and Dublin. Its position is therefore a most important one.

Electrical communication has already been established with the Kentish Knock light-vessel, and the Maplin and Gunfleet lighthouses, and if the *Tongue* and *Sunk* light-vessels are connected, the chain of communication between the light stations guarding the shoals at the entrance to the Thames will, in the Commissioners opinion, be sufficiently complete.

(2.) *Outlying Lighthouses.*

The Commissioners recommend that the following outlying lighthouses should be placed in telephonic communication with the mainland as soon as possible:—Walney Island, Skerries (Anglesea), South Bishop, and Godrevy. Walney Island lighthouse is situated on the south-east point of Walney Island and has a good look-out over the shoals at the entrance to Morecambe Bay and Piel Harbour. The Skerries lighthouse is situated on an islet about two miles from the nort-west point of the Island of Anglesea. It commands a view over a number of dangerous rocks upon which many casualties have occurred, and there is a very large passing trade. It would also be a useful station for the display of storm-warning signals. The South Bishop lighthouse guards a number of dangerous reefs known as the Bishops and Clerks, which lie about four miles from the coast of Pembrokeshire. Strong tides run past these rocks, and there is a considerable passing trade. Godrevy lighthouse is situated on a large rock about a quarter of a mile from the north coast of Cornwall, and commands a view over St. Ives Bay and a reef of rocks, known as the "Stones," which run straight out to sea for a distance of about one mile and a half from the mainland. A large number of coasting vessels and fishing boats pass near the exposed coast visible from the lighthouse, which, although it is so near the shore, should be connected. The question of connecting Bardsey Island, Farn Islands, and certain other outlying lighthouses will be well deserving of consideration in the event of an economical system of ethereal communication being perfected, but the Commissioners refrain from recommending those stations at present, owing to the cost of their connection being disproportionate to its probable advantages.

(3.) *Shore Lighthouses.*

The Commissioners recommend that the following shore lighthouses should be placed in telephonic communication with the general telegraph system of the country by means of aerial wires:—Portland Bill (High Light), Beachy Head, South Foreland (High Light), Buchan Ness, Noup Head (when finished), Bressay, Scalpay, Rudha Mhail, Fanad Point, Killybegs (St. John Point).

(4.) *Storm-warning Signals.*

They recommend that storm-warning signals should be displayed at the following lighthouses:—Portland Bill, Needles, Beachy Head, Noup Head, Sunburgh Head, Scalpay, Rudha Mhail, Rhynns of Islay (Oversay Island), Walney Island, Skerries (Anglesea), South Bishop, Smalls, Caldy Island, Godrevy, Fastnet, Fanad Point, Killybegs (St. John Point).

Electrical communication has already been established with six of these stations (*Needles, Sumburgh Head, Rhynns of Islay, Smalls. Caldy Island, and Fastnet*), and the Commission recommends that arrangements should be made for the display of the signals at those lighthouses as soon as possible. In the case of the other stations which have been selected it will be necessary to wait until they have been connected.

Storm-warning signals are already displayed at 25 lighthouses round the coasts of the United Kingdom, in accordance with the recommendation made in the Third Report, and the Commissioners are of opinion that when the lighthouses which have just been named are also utilised for this purpose these will afford a valuable addition to the facilities for learning the probable approach of storms on our coasts.

Continuance of the Work of Establishing Electrical Communication with Light-vessels and Lighthouses.

The Commissioners are of opinion that, if the above recommendations are adopted, all the most urgent cases will have been dealt with, and that a very fairly complete system of electrical communication with light-vessels and lighthouses in the United Kingdom will have been established. The necessity of connecting shore lighthouses is not so great as it was when they first undertook the task entrusted to them as under the Coast Communication Scheme, which has been carried on concurrently with, but independently of, the system of electrical communication with light stations, a line of wires, joining coastguard stations with one another, and with the general telegraph system of the Kingdom, has been drawn round a large portion of our coasts, and when a coastguard station near a lighthouse is electrically connected, and has a good look-out over the sea, the connection of the lighthouse itself is, in their opinion, generally unnecessary. There are, moreover, many public signal stations in the vicinity of lighthouses, and where these stations are found, the necessity of connecting the neighbouring lighthouses does not, as a rule, exist.

In the case of light-vessels and outlying lighthouses at some distance from the shore the circumstances are different, and the Commissioners are of opinion that stations of those two classes will be found to have the strongest claims to consideration, if the work of establishing electrical communication with lighthouses and light-vessels is still further extended. In view of the probability of such extension, they consider it desirable to explain briefly the lines which they have followed in selecting the stations which they have recommended for connection.

The Commissioners have held that where a light-vessel or a lighthouse has a good look-out over dangers to navigation which are not, under ordinary circumstances, within easy visual range of any other efficient and reliable look-out station, and where the light-vessel or lighthouse itself is so far away from the nearest point from which assistance can be called as to render visual or sound signals unreliable, there is a *primâ facie* case for considering the question of establishing electrical communication. The questions next in importance to be considered are, in their opinion, (1) whether, if electrical communication were established, lifeboats or other means of affording assistance to vessels and their crews are to be found sufficiently near the light station to render it probable that they would arrive in time to be of use; (2) the number of casualties to vessels and of lives lost in the neighbourhood of the station; (3) the amount of the passing trade; (4) the value of the establishment of electrical communication for the purpose of supplying the station (if a lighthouse) with storm-warnings, which can be signalled to passing vessels.

If these points can be answered in favour of the connection of the station, the questions which remain to be considered are (1) whether it is practicable to effect and maintain electrical communication, and (2) whether the advantages which may be expected to result from the establishment of communication are likely to bear a reasonable proportion to the expense involved. Although the Commissioners have been chiefly guided by these general considerations, they have felt bound to recommend, for other reasons, the connection of stations where some of those conditions do not exist, while in almost every instance they have found much difficulty in forming any real estimate of the probable value of the connection, except such as can be deduced from the volume of the passing trade and the number of casualties which have occurred in the neighbourhood. It is, of course, obvious that the advantages which may be expected to result from the connection of a light station, which is far removed from the ordinary trade routes and in the neighbourhood of which casualities are rare, are, *ceteris paribus*, likely in the long run to be less than those arising from the connection of a light station overlooking crowded and dangerous waters, but it must not be expected that important results will necessarily follow at once the establishment of electrical communication with a station, even though its position is such as to render its claims to connection undeniable. Electrical communication with lighthouses and light-vessels is likely to prove of the most conspicuous utility in cases in which vessels meet, in the neighbourhood of a light station, with a casualty of a nature to involve their speedy destruction, and in such cases the existence of telephonic communication may be of vital importance to all on board.

Fortunately casualties of that kind are comparatively rare, and, generally, timely help can be summoned by means of sound or visual signals; but the possibility that at any time a number of lives may be dependent upon the existence of a telegraph wire or cable to a light station, seems to confirm the importance of electrical communication with lighthouses and light-vessels.

Schedule of Recommendations.

1. Electrical communication to be established with the following light stations:—(*a*) *Light-vessels.*

Name.	To be electrically connected with	Estimated cost of cable and laying.	Estimated cost of land line.	Estimated total cost.
		£	£	£
East Goodwin ...	Kingsdown C.G.S.	1,425	40	1,465
Cross Sand	Winterton C.G.S.	1,815	70	1,885
Kish	Kingstown C.G.S.	2,625	75	2,700
Tongue	Kingsgate C.G.S.	1,890	40	1,930
Sunk	Walton-on-Naze C.G.S.... ...	2,040	40	2,080
			Total £	10,060

The above estimates are based upon the present system of connection, but do not include the cost of the necessary fittings and moorings provided by the lighthouse authorities.

(*b*) *Outlying Lighthouses.*

Name.	To be connected by telephone with	Estimated cost of cable and laying.	Estimated cost of land line.	Estimated total cost.
		£	£	£
Walney Island ...	Barrow P.O. ...	60	290	350
Skerries (Anglesea)...	Kemaes C.G.S. ...	1,640	265	1,305
South Bishop ...	St. David's C.G.S	1,715	80	1,795
Godrevy	Gwithian C.G S.	840	100	940
			Total	£4,990

(*c.*) *Shore Lighthouses.*

Name.	To be connected by telephone with	Estimated cost.		
		£	s.	d.
Portland Bill (High Light) ...	Easton P.O. ...	40	0	0
Beachy Head	Beachy Head C.G.S.	47	0	0
South Foreland (High Light)	St. Margaret's C.G.S.	70	0	0
Buchan Ness	Boddam P.O. ...	23	0	0
Noup Head*	Westray P.O. ...	155	0	0
Bressay	Bressay P.O. ...	72	0	0
Scalpay	Scalpay P.O. ...	140	0	0
Rudha Mhail	Portaskaig P.O. ...	95	0	0
Fanad Point	Portsalon P.O. ...	290	0	0
Killybegs (St. John Point) ...	Dunkineely P.O. ...	197	0	0
... ...	Total	£1,129	0	0

* When finished.

2. Storm-warning signals to be displayed at the following lighthouses:—

Portland Bill.*	Rudha Mhail.*	Caldy Island.
Needles.	Rhynns of Islay.	Godrevy.*
Beachy Head.*	Walney Island.*	Fastnet.
Noup Head.*	Skerries.*	Fanad Point.*
Sumburgh Head.	South Bishop.*	Killybegs.*
Scalpay.*	Smalls.	

* When connected.

The approximate annual cost of the warning telegrams sent from the Meteorological Office to the above lighthouses may be estimated at about £21. In addition the cones by which the signals are made will have to be provided. Their cost is about 12s. 6d. for each station.

The report is signed by the Earl of Mount Edgcumbe, Baron Dunleath, Sir Edward Birkbeck, Sir F. Leopold McClintock, Sir George S. Nares, Messrs. J. C. Lamb, W. H. Preece, John A. Kempe, R. Munro Ferguson commissioners, and Mr. Ernest G. Moggridge, secretary, and is dated September, 1897.

Erratum.—On p. 784, second column, last two lines of fifth paragraph, read "after a two years' trial in 1886," not 1896.

NOTES ON MODERN PRACTICE IN ELECTRIC POWER WORK AND RECENT DEVELOPMENTS ON THE NORTH-EAST COAST.

By Mr. D. SELBY BIGGE.*

In May, 1894, the writer read a paper before this Institution on the subject of the application of electricity as a motive power for various industrial purposes, dealing chiefly with its application to the driving of works machinery.

Your President, Mr. Westgarth, suggested to the writer, recently, that a short paper dealing with the developments which have taken place since the reading of this paper, three years ago, might prove of interest to the members of this Institution.

In the interval of time which has passed great strides have been made, and electrical driving has passed out of its experimental and probationary stages, and become a reliable system to which every engineer can turn, when contemplating the re-modelling of old works, or the laying down of new ones.

In no part of the country has the progress made in electric driving been so marked and rapid as upon the North-East Coast, in fact, it may truly be said that the engineers of the Middlesbrough, Hartlepool, and North-East Coast districts have, to a very large extent, been the pioneers of the system in this country, and it is, therefore, a matter of sincere gratification to the writer to have the opportunity of laying before the members the result of his more recent experience gained in this particular branch of engineering.

Five years ago we had but little to show in this country in the shape of driving works electrically, and the writer found it, therefore, necessary, and often an uphill task, to induce engineers to visit the Continent to see for themselves installations, and to judge of the practical advantages of electric driving.

In the course of time, however, a number of gentlemen from this district paid visits to the Continent, and the initiative was soon taken in a small way at the works of Messrs. Dorman, Long & Co., Limited; the system proved a success, was rapidly extended and developed, and found its way into the neighbouring works in the district.

In order to bring this development on the North-East Coast more clearly before you, the following list of some of the firms who have adopted the system may prove of interest; this list might be augmented by the addition of installations with which the writer is unacquainted:—

Messrs. Dorman, Long & Co., Limited, Britannia Iron Works, and West Marsh Works, Middlesbrough.
Messrs. Chas. Dorman & Co., Bedson Wire Works, Middlesbrough.
Messrs. Bell Bros, Limited, Clarence Iron Works, Middlesbrough.
Carlin How Mines, Carlin How.
Lumpsey Mines, Brotton.
Messrs. Sir Raylton Dixon & Co., Limited, Shipyard, Middlesbrough.
Messrs. R. Craggs & Sons, Tees-side Shipyard, Middlesbrough.
Messrs. The Anderston Foundry Company, Limited, Port Clarence, Middlesbrough.
Messrs. Sir Chris. Furness, Westgarth & Co., Limited, Tees-side Engine Works, Middlesbrough.
Messrs. The North Eastern Steel Company, Limited, Steel Works, Middlesbrough.
Messrs. The Skinningrove Iron Company, Limited, Skinningrove Iron Works, Carlin How.
Messrs. Furness, Withy & Co., Limited, Middleton Shipyard, Hartlepool.
Messrs. Wm. Gray & Co., Limited, Central Shipyard, North and South Shipyards, West Hartlepool.
Messrs. Thos. Richardson & Sons, Limited, Hartlepool Engine Works, Hartlepool.
Messrs. Irvines Shipbuilding and Dry Docks Co., Limited, The Harbour Dockyard, West Hartpool.
Messrs. Short Bros, Pallion, Sunderland.
Messrs. R. & W. Hawthorn Leslie & Co., Limited, Hebburn Shipyard, Hebburn-on-Tyne.
Messrs. The Tees-side Bridge and Engineering Company, Limited, Middlesbrough.
Messrs. Palmer's Shipbuilding & Iron Co., Limited, Jarrow.
Messrs. C. S. Swan & Hunter, Limited, Wallsend.
Messrs. The North-Eastern Marine Engineering Company, Limited.
Messrs. The Sunderland Forge Company, Limited.
&c., &c.

The above list is representative only of what has been done on the North-East Coast, and does not refer to the numerous installations which have been started in other parts of the country. It will, however, clearly indicate the rapid development which has taken place in this particular district.

No more forcible instance of the application of electricity can be found, than in those cases where it has been applied to the driving of shipyards or iron and steel works which contain a number of scattered engines. Works such as these, which have been added to from time to time, are frequently very uneconomically driven, and it seems almost paradoxical to find marine engineers and shipbuilders who manufacture or employ engines of the highest efficiency known, and lay such great stress upon low coal consumption, employing the most uneconomical methods possible in the driving of their own works. In many cases the ramification of steam pipes alone forms, as it were, a huge condenser, in which the greater portion of the steam is condensed before ever reaching the engines it is intended to drive.

In some cases the total coal consumption has been found to be as great as 15 to 20 lbs., and frequently 10 lbs. of coal per horse-power of actual work done by the various machines throughout the works. From a central power station of modern design, the same power can be given out by the machines in any part of the works, for an expenditure of 2½ to 3 lbs. of coal per actual horse-power work done, inclusive of all losses in engines, dynamos, cables, switching gear and motors.

In the case of an ordinary sized works, the loss to be allowed for in the transmission of power through the cables should not exceed 3 or 4 per cent., this, however, is an item which is almost entirely controlled by the capital one is prepared to invest in the copper conductors.

One of the most important and remarkable features of electric power installations is the very low cost of the annual upkeep. When once the plant is laid down on thoroughly efficient and permanent lines, the maintenance over a number of years is exceedingly small, say, 2 or 3 per cent. on the original cost of the plant. What repairs may be needed to the motors can almost invariably be carried out at the works, and the monetary value of the repairing work when required is trifling. The results which have been obtained in the running of the different shipyards are most encouraging and satisfactory. The first shipyard in this country to be exclusively driven by means of electricity was that of Messrs. Furness, Withy & Co., Limited, Hartlepool.

It has been found that the wear and tear on the machine tools themselves has been considerably decreased owing to the very steady

* Read before the Cleveland Institute of Engineers, November, 1897.

running of the motors driving the tools, the constant vibration of the steam engines, which were hitherto driving these tools, having caused deterioration to the machinery.

Taking the case of a shipyard first, it has been found that the greatest economy is obtained when the whole of the driving power is concentrated in one central plant, consisting of one, two, or three units, as the case may be. The average sized shipyard can be driven electrically, exclusive of lighting, by an engine indicating no more than 200 to 300 H P.

When this power is concentrated in a triple-expansion engine using not more than 1½ to 2 lbs. of coal per indicated H P. per hour, the economy derived is found to be very great, as the majority of our shipyards are necessarily most uneconomically driven, owing to the large number of scattered engines, which it has been found necessary to make use of.

Every machine that is found in a shipbuilding yard can be driven electrically, with the one exception of the steam hammers in the forge. These hammers are a source of great waste, and it may be hoped that before very long we shall be able to find some substitute for this wasteful machine.

In the case of hydraulic machinery for driving jib cranes, riveters, man-hole punches, &c., it has been found advisable to drive the electric pumps with a motor, leaving the hydraulic system alone as it exists. The power absorbed by the use of hydraulic pumps in connection with shipyards usually amounts to 40 or 50 H.P., and ample margin should be allowed for in the motors driving this class of machinery.

Special electric winches have been designed for shipyard use, and these have proved very serviceable. They are, as a rule, provided with 7 to 8 H.P. motors, and are capable of doing all that the steam winches did before them, and in a very much more economical manner. The steam winches in a shipyard are generally a source of great waste of steam, as the pipes have to be usually laid underground, where it is hard to maintain them in good condition and avoid leakages of steam.

All the outlying punches, shears, and this class of machinery, can be very simply and quickly adapted from steam to electric driving. The motor is usually placed on a platform above the machine, but in some cases where this cannot be done it is bolted either to the side of the punching machine or placed below the ground level. The size of motors usually employed in the driving of this class of machinery are motors of 5, 7, or 10 H.P.

One noticeable point about the introduction of electric driving in shipyard work is, that the whole of the yard can be changed from steam to electricity without any real stoppage to a single machine in the yard. The motors are placed on their respective foundations, the wires laid to them, the switching gear and registering instruments fixed up, and at the dinner hour the belt is removed, or the connecting rod of the engine is taken off, and the motor is set to work. All that is necessary can usually be arranged to be done in the dinner hour, or at night time.

Owing to the very intermittent nature of the working of machinery in a shipyard, the total power indicated at the central generating station is found to be much smaller than what might ordinarily be expected, considering the total horse-power of the machinery that is being driven.

It is hard to arrive at the exact ratio, as this varies in every individual case, but from practical experience it may be taken, that 300 electrical H.P. is capable of driving at least 450 H P. of motors. This is in connection with regular shipyard work. Very much the same proportion may be taken for installations of a similar nature.

In making a calculation as to the size of the generating plant, one is very well on the safe side in allowing for 65 per cent. of the total H P. of the motors involved in the installation, as representing the actual electrical H.P., which would be required at the generating station to drive them. Of course the allowance for lighting purposes would be over and above this figure.

It may be interesting to give a list of the various powers absorbed by shipyard and other machine tools when running light and heavy laden. In many cases a great part of the power is expended in getting the machines under weigh and keeping them running irrespective of what work they may be doing:—

	E.H.P.
Double Punch—	
Running light	2·0
Punching both ends, 1-inch hole, ⅞-inch plate, 28 punches per minute at each end	5·0
Punch and Shear—	
Running light	2·0
Punching hole as above and shearing ⅞-inch plate, 5½-inches cut, 28 strokes per minute	6·5
Large Plate Bending Rolls—	
Running light	5·5
Rolling plate $\frac{9}{10}$-inch thick × 4 feet 4 inches wide × 16 feet 6 inches long, endways on (4 feet 4 inches)	6·9
Sideways on (16 feet 6 inches)	12·2
Plate $\frac{11}{10}$ inch × 4 feet 8½ inches × 21 feet long sideways on	19·3
Same Rolls Lifting and Lowering Top Roll—	
Lifting	8·5
Lowering	7·0
Forcing $\frac{11}{10}$-inch plate down	10·0
Forge Fan—	
For 24 fires	10·5
Angle Squeezer—	
Running light	·8
Squeezing	2·5
Wood-working Machinery—	
Small plane	·8
Tenoning machine	·8
Band saw	1·5
Cross cut saw	2·5
Small circular saw cutting 6-inch pitch pine hand fed	6·4
Circular saw 18 inches, sawing 18-inch teak (6 feet 6 inches) per minute	24·0
Sawing 4½-feet teak, 25 feet per minute	17·7
Countersinking Machine—	
Actual power taken in countersinking	3·5
Riveting Machine—	
Running light	1·6
Riveting	3·0
Wall Planer—	
Taking ⅜-inch cut cast-iron	5·0
Radial Drill—	
Drilling $1\frac{1}{4}$-inch hole cast-iron	1·59
Plate Planing Machine—	
Running light	·6
Reversing light	1·8
Cutting 1-inch × 14 feet plate	3·1
Stern Frame Boring—	
Cutting	1·75
Shafting Lathe 18 Inches Centre—	
Running light	·5
One tool cutting $\frac{1}{16}$-inch square cut	1·8
Two „ „	2·5
Lathe 9-Inch Centre—	
$\frac{3}{16}$-inch cut	·6
Angle Cutting Machine—	
Running light	1·6
Cutting angle 6 inches × 3½ inches × ½ inch	3·5
Winch—	
Lifting 28 cwt. single purchase, 50 feet per minute	6·5
Ending Machine—	
Running light	1·9
Cutting girder 18 inches × 7 inches	4 to 4·8
Cold Saw—	
Running light 24-inch saw	2·0
Cutting 4-inch by 4-inch angle	4 to 45
Air Compressor—	
10-inch × 14-inch cylinder, 50 lbs. pressure	15 to 23·5
Portable Drill—	
When drilling 1 inch hole	1·5
Hydraulic Pump—	
Three rams 3⅜-inch diameter; 4½-inch stroke, 60 strokes per minute. Pressure 870 lbs. Power taken	38·0
Joiner's Shop Motor—	
Normal load	14·8 to 22
Machines being driven from this motor—	
One 20-inch plane.	
One circular saw 24-inch.	
One 30-inch planing and sandpaper machine.	
Electric Winch—	
Running light	1·2
Lifting 24 cwt. 16 feet per minute	5·6

A great deal of what has been said with regard to shipyards applies also to iron and steel works, although the powers may be found to be somewhat heavier, and the size of the plant necessary for the driving of the works, to be more powerful.

In addition to the ordinary outlying machinery, shops, hydraulic plant, all the small live-roller gear engines, skid engines, capstans, winches, &c, can be advantageously replaced by electric motors. Plate rolls, mangle rolls, and other similar machines, are easily adapted for electric driving.

In the case of purely engineering works, consisting of engine and boiler shops, the power is generally sub-divided up into the driving of the various line shafts, large machine tools, wood-working departments, blowers, overhead cranes, jib cranes, &c., while, of course, the electric lighting is always embodied in the power plant.

As to the plant for the central power station, no hard and fast rule can be found for this, as some works are driven in departments and others as a whole. Generally speaking, however, the fewer number of units which can be employed the better. The driving of the whole works should not be split up into more than two, or at the most three, units of power.

Too much attention cannot possibly be paid to the economical means of producing electricity. Of course, in those cases where waste gases are available, it is highly desirable to lay down boilers to be driven off those gases. In ordinary cases, however, either compound or triple-expansion plants working at high pressure of steam, and provided with the best condensing arrangements, should be made use of; otherwise half of the advantages which would accrue from the system of electric driving will be lost, as it is in reality, the use of electrical distribution, which permits of the employment of a highly efficient generating plant.

Above certain powers, say, 150 H.P., direct-coupled plants running at moderately slow speeds will be found the most suitable for electric driving.

During the past year a fresh development has taken place in this country by the introduction of polyphase machinery. The main characteristics of this class of machinery being that the motors and generators are devoid of commutators and brushes, with the exception of small starting rings used only in the starting of the motors.

The machinery, as you will be aware, is built upon the alternating current principle, and is usually wound for two or three phases. In the case of large generating machines, the generator is very much simpler in construction, less costly, and is of the same efficiency as the continuous current machinery of the same size.

There are many special advantages in connection with the use of polyphase machinery, as in the case of having to run machines a long distance off, the pressure can be raised to any extent. In long distance transmission high tension currents are made use of and transformed down again for use in the motors driving the works. In the case of works of limited area the voltage of the plant employed is practically no higher than that which is usually used with continuous current machinery, and no danger whatsoever to the workmen is possible to happen.

Such a case as this may be seen at the recent installation, with which the writer has been connected, at Messrs. Thos. Richardson and Sons' works at Hartlepool. This is one of the first installations on any large scale which has been laid down in this country upon this new system, and before long data will be forthcoming to show the success of the working of this installation.

The polyphase system has been adopted in this district by Messrs. The North Eastern Steel Company, of Middlesbrough, Messrs. R. and W. Hawthorn Leslie & Co., of Hebburn-on-Tyne, and Messrs. Palmer's Shipbuilding and Iron Company, Limited, of Jarrow.

It would be useless at the present stage to attempt to predict all the future developments in electric power work. Apart from its special application to the driving of works, electric traction has been greatly developed and perfected, and considerable improvements are daily being made in the propulsion of boats and carriages.

The field for electric power applications is opening up in all directions, and a large and increasing industry is being developed.

Your president, Mr. Westgarth, was amongst one of the very first in this district to appreciate the advantages of electric driving, and when he obtained possession of his new works showed his belief in the system, by laying down a very fine and complete installation for the driving of the entire works.

In conclusion, the writer trusts that the subject of his paper may have proved opportune, and have been of some interest and service to the members of this Institution.

A NOVEL SUGGESTION re APPRENTICES.

Mr. R. I. Napier, of Glasgow, makes a suggestion in a letter to a contemporary which seems to be worth careful consideration. He looks on the present system of apprenticeship as barbarous. At one time a fitter was expected to drill and tap on the square, to file and chip flat, and so on, and as he spoiled a lot of stuff in learning, he was expected to work, until a man, at less than he was really worth. Yet now a young fellow can work a machine to profit in a month, and is still paid only nominal wages for five years, so that he gets to look on his employer as owing him arrears, and combines with others to take it out of the employer: be that employer the one who has owed him the arrears or not, might be added.

Mr. Napier would double the number of boys engaged, put a good hand in charge of them, and at the end of the year he would weed them out, sending the second-rate fellows to fill other posts, for which there are plenty that will suit them better, while the year's discipline in an engine shop would do them no harm. At the end of the first year the survivors would be paid what they are worth. Thus at once would be removed the stigma from employers of paying less than is due to perhaps really able boys, and the lads would have some inducement to do other than throw the waste bag about, or sit in undiscovered pits with the forbidden cigarette, as once a usual practice on Tyne Bank.

Mr. Napier considers that the change would meet the public approval, and we are inclined to think it would. Apprenticeship is now not so much as once it was a question of handicraft, and what puzzles us, is how those who must be skilled in handicraft can get experience as learners. Recent experience with members of the A.S.E. has shown us that many of them have no right to the title of tradesmen. They seem absolutely devoid of any knowledge of how to set out work, and how to proceed in the simplest of cases. The A.S.E. seems to have become simply a stepping stone to the power to demand a minimum wage by any man who cared to join. A real trades union ought to have an admission examination. Examinations in handicraft can be far easier arranged than the ordinary technical examination. It would be easy to set a man to put up a half dozen lengths of shafting of different diameters, true and level with couplings properly set, and wheels geared and keyed correctly, or to set a boring bar in a cylinder, or file up the conventional hexagon head, or chip and file a rough cast strip to an even surface, to make a straight edge or a set of three without a copy, or do many little jobs to prove ability. Membership would then prove fitness and be a guarantee, which it now certainly is not.

Certain also it is, that the introduction of so much machinery has completely changed all the conditions of the working engineer's life. America has been able to take advantage of the change, because being a growing country, trained men have not been even nominally available, and labourers have perforce been employed.

With ourselves there has been a larger supply of nominally skilled labour, and the unions have made the mistake of trying to stem progress by arrogating to so-called skill the sole right to do mechanical work. In doing this they have restricted apprentices, until there are not to-day as many really skilled men as there is work for them to do, and in everything the unions have gone the exactly opposite way to secure success, curtailing output until the employment of lower paid, but equally or more efficient, labour has become imperative. Simply because they have been led wrong the men to-day are beaten, their places in many instances are filled, and the way paved for the introduction of an entire change of shop management. This change might have been effected slowly and without unpleasant shock to any one, but the men dammed the rising waters of change and progress until they have been swept away by the accumulation of a driblet that would not have made its effects palpable if spread over 20 years as would but for obstruction have been the case. The men are now trying to dam the effects of their damming.

HERTZIAN TELEGRAPHY IN FRANCE.

A paper was read by M. Ducretet on the 19th ult. before the Société Française de Physique on the above subject, and he showed some of his apparatuses, by means of which it is possible to carry out Hertz's experiments on electric waves. It was shown to be possible, without making any alterations or changes in the existing apparatus which is employed for this purpose, to produce either continuous or intermittent electric waves, to transmit them to a distance, to receive them and to record them. The transmitter shown was a Hertz oscillator with two spheres, which are immersed in an insulating fluid in just the same way as Prof. Righi does with his large oscillators. This immersion in a liquid insulator is due to MM. Sarasin and De la Rive; it ensures constancy in the production of oscillating discharges, and the electric waves produced are more energetic.

The model shown by M. Ducretet was of small dimensions and intended for lecture purposes. The small capacity of the spheres was sufficient to produce the oscillating discharge and to obtain very short wave lengths.

This oscillator is actuated by a small Rhumkorff coil, placed in the same manner as Prof. Bose does, in a box with metallic sides and provided with a contact key in order to obtain short or long discharges, and as a result produce intermittent waves.

The Hertz spark resonator is replaced by one of M. Branly's tubes with filings. The filings, enclosed in a tube and placed between two conductors, forming a circuit with a battery and a galvanometer, offer a very large resistance to the passage of a current; it becomes a good conductor when excited by an electric wave. This conductivity ceases suddenly, and is renewed when a fresh wave strikes the tube. This sensitiveness is very marked and shows itself at a distance. M. Branly, to whom the discovery of this is due, calls these receivers "*radio-conducting tubes*." They are the principal and indispensable part of the apparatus for the reception of electric waves at a distance.

M. Ducretet described the apparatus constructed for M. Popoff in 1895, which was made use of in St. Petersburg to receive and record electric waves as they were produced. In this case, the receiver is again a Branly tube with filings, placed in circuit with a battery and a relay which is actuated directly the Branly tube is affected by an electric wave emitted from a distance. The relay closes a circuit in which there is an electric bell, the hammer of which, however, instead of striking a gong, taps the sensitive tube, and so automatically restores it to its initial resistance directly the electric wave has ceased to act on it. The circuit comprises, besides this "bell," a registering apparatus to keep a record of the waves as they are received.

This apparatus, the result of well-known researches, permits of the production, transmission, reception, and recording of the electric waves; whether they are produced by atmospheric discharges or by means of an oscillator, it only remains to adapt its power according to the distance to be traversed.

M. Ducretet has made some alterations in the arrangement of the circuits; he makes use of a sensitive galvanometric relay, similar to those used in telegraphy, which he constructed with the help of MM. Maréchal and Rigollot; it is fitted with a damping arrangement, and an additional resistance is provided in order to suppress the "breaking spark," as they call it. The Morse register forms a second relay.

Without altering anything which has been described, M. Ducretet showed that the transmission and reception of these luminous waves enables signals sent across a space to be registered. M. Ducretet terms this application "Hertzian telegraphy."

M. Marconi was, no doubt, when making use of the known apparatus with which he transmits signals across space without wires, not aware of these researches.

M. Ducretet showed how the apparatus were, according Prof. Bose, to be arranged in order to carry out all the Hertz experiments, to show the analogy existing between the electric waves and the luminous waves; "reflection, refraction, diffraction, polarisation." The apparatus is not large; the receiver, fixed on the pointer of a goniometer, is M. Branly's, or the one proposed by Prof. Bose, and is derived from the *radio-conductor* with filings. All the parts forming the transmitter must be completely enclosed in a metallic box. An ebonite lens serves to concentrate the electric rays.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

27,303. "Improvements in prepayment electricity meters." C. A. Baker. Dated November 22nd.

27,345. "Improvements in sockets for incandescent lamps." G. Jaeger and H. Bender. Dated November 22nd. (*Complete.*)

27,346. "Improvements in sockets for incandescent lamps." G. Jaeger and H. Bender. Dated November 22nd. (*Complete.*)

27,357. "Means to be employed for charging a small number of accumulator elements from high voltage electric currents." C. Brault. Dated November 22nd.

27,366. "Improvements in electrical switches." J. Gutmann. Dated November 22nd.

27,372. "Improvements in the construction of the glass bulbs of electric incandescent and other lamps." C. E. Muller and R. F. Hurban. Dated November 22nd.

27,374. "Improvements in the construction of transformers, choking coils, and similar electric appliances." W. L. Davies. Dated November 22nd.

27,380. "Improvements in, and relating to, electrical cut-outs and fittings." G. M. Sellick. Dated November 22nd.

27,387. "Electro-therapeutic exercising apparatus." A. Martin. Dated November 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 10th, 1897, being date of application in France.)

27,398. "An improved means for indicating the duration of conversations in public telephones." A. Ewald and Max Friedlaender. Dated November 22nd.

27,428. "Improvements in, and connected with, electric furnaces for the production of calcium carbide and other substances." H. S. Riant. Dated November 23rd.

27,430. "Improvements in fixed and portable electrically driven circular sawing, moulding, rebating, planing, and surfacing machinery." G. Cameron. Dated November 23rd.

27,433. "Improvements in electric cables." G. H. Nisbet and D. Bates. Dated November 23rd.

27,451. "Improvements in fastenings for boxes for electric accumulators and the like." E. R. Dale. Dated November 23rd.

27,483. "Improvements in connection with electric arc lamps." P. Spies, W. H. Newall and A. W. Shout. Dated November 23rd.

27,494. "Improvements in the method of, and means for, regulation of alternating current systems." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 23rd. (*Complete.*)

27,495. "Improvements in starting devices for alternating current motors." The British Thomson-Houston Company, Limited. (W. J. Foster, United States.) Dated November 23rd. (*Complete.*)

27,496. "Improvements in dynamo-electric machines of the inductor type." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 23rd. (*Complete.*)

27,508. "Improvements in and connected with the extraction of gold by electrolysis." O. March. Dated November 23rd.

27,509. "A new or improved meter for electric current." J. Mohrle. Dated November 23rd.

27,543. "Improvements in electric cables." J. D. Gould. Dated November 23rd.

27,551. "Improvements in means to be employed in the electrolysis of salts." J. W. Swan and A. C. Hyde. Dated November 23rd.

27,598. "Improvements in electrical fusible cut-outs." G. Byng. Dated November 24th.

27,619. "Improvements in incandescent electric lamps." R. Nordmann. Dated November 24th.

27,672. "An improvement in the application of heat (by gas, electricity, or any other source of heat controllable by a tap or switch) to the sterilisation of water, the process is rendered noiseless and automatic." C. A. Owen. Dated November 25th.

27,683. "Improvements in and connected with electrical storage batteries." W. H. Lane. Dated November 25th.

27,695. "An improved switch for the making and breaking of high voltage electric currents." S. E. Foster. Dated November 25th.

27,706. "Improvements in barrelling electro-metallic depositing apparatus." J. E. Hartley and H. E. Hartley. Dated November 25th.

27,707. "Improvements in rotative electro-metallic depositing apparatus." J. E. Hartley and H. E. Hartley. Dated November 25th.

27,712. "Improvements in electrodes for welding and soldering by means of electricity." A. Hirsch. Dated November 25th.

27,714. "Improvements on those systems of electric tramways and railways in which current is collected from two insulated conductors (positive and negative) such improvements being in connection with crossings and turn-outs." J. Johnston. Dated November 25th.

27,715. "Improvements in incandescent electric lamp globes, and in the manufacture of the same." G. S. Hingley. Dated November 25th.

27,725. "Improvements in the construction of accumulators." H. Leitner. Dated November 25th.

27,749. "Improvements in arc lamps." W. J. Davy and G. Pollock. Dated November 25th.

27,765. "Improvements in electric arc lamps." T. Spencer. Dated November 25th. (*Complete.*)

27,805. "Improvements in electric lampholders." A. Watson. Dated November 26th.

27,806. "Improvements in electrical switches." A. Watson. Dated November 26th.

27,807. "Improvements in and in the manufacture of switches for electrical purposes." A. Watson. Dated November 26th.

27,812. "Improvements in electrically propelled vehicles." R. McDonald. Dated November 26th.

27,844. "An apparatus for gripping and removing, or placing in their holders, electric incandescent lamps, globes, and other articles." F. N. Haward and H. H. Cass. Dated November 26th.

27,845. "Improvements in arc lamps and in magnet winding for same, and other purposes." J. D. F. Andrews. Dated November 26th.

27,837. "Improvements in electrical indicators for use on public and other vehicles." H. White and R. C. Graham. Dated November 26th.

27,861. "Improvements in electric cables." H. Edmunds. Dated November 26th.

27,875. "Improvements in electric lifts." A. Soames. Dated November 26th.

27,888. "Electric furnaces." C. S. Bradley. Dated November 26th. (*Complete.*)

27,926. "Improvements in cable or conductor ways and connections therefor underground electric traction." J. Carr. Dated November 27th.

27,940. "Improvements in electric batteries." M. Orban. Dated November 27th.

27,970. "Improvements in dynamos and motors." A. W. Smith. Dated November 27th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 3rd, 1897, being date of application in United States.)

27,973. "Improvements in charging secondary batteries or accumulators." C. Clark. Dated November 27th.

27,980. "An alternate current electric motor." C. Tuson. Dated November 27th.

27,982. "Improvements in primary batteries." W. Rowbotham. Dated November 27th.

27,995. "Improvements in or connected with devices for protecting electric circuits and apparatus from injury by excessive electrical potential due to lightning or other cause." V. A. Fynn. Dated November 27th. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free*, 8½*d.* (*in stamps*).]

1896.

14,639. "Improvements in apparatus for the production of electricity from the waste heat of gas, steam, or other heat engines." H. J. Dowsing. Dated July 2nd, 1896. Electricity is generated from the waste heat of gas, steam, or other heat engines, by causing same to heat a thermopile. A thermopile is fitted in a flanged insulating support placed around the exhaust pipe of the engine, but the battery may be connected with the ignition tube, the cylinder, the flue or chimney, of a steam boiler, or other parts of the engines.

15,223. "Improvements in or relating to the production of electricity." H. F. Kirkpatrick-Pucard. Dated July 9th, 1896. Electricity is produced by the consumption of carbon in an electrolyte composed of a molten metallic oxide which is decomposed more readily by the carbon than by the metal vessel in which it is held, and which forms the other element. The metal vessel may be of copper, and the oxide may be litharge diluted with sodium oxide, caustic soda or potash, silicates, &c. The oxide is regenerated by a blast of air or oxygen.

15,303. "Improvements in the method of and means for protecting electric lamp fittings from damp and corrosion, and for preventing short-circuiting." J. L. Kendal. Dated July 10th, 1896. In order to protect lampholders from fumes and damp in chemical works or under water or elsewhere, the holder is connected to lead-covered or other conductors, which are passed through holes in a cap made of rubber containing little sulphur. The lamp is enclosed by a glass cover provided with a flange, which is clamped against the edge of the cap by a rubber ring and two porcelain or earthenware rings screwed together, and may support a paper-mâche shade.